PALUDISM

No 3 July 1911

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LIST OF PLATES

* These mosquitoes were described on pages 64 and 6[illegible] of Paludism No. 2

The Central Committee for the study of malaria in India record with profound regret the death, on the 27th March 1911, of their late President, Lieutenant Colonel J T W Leslie, C I E, I M S For more than fourteen years Lieutenant Colonel Leslie, first as Secretary to the Sanitary Commissioner with the Government of India, afterwards as Sanitary Commissioner, laboured with untiring zeal and industry to advance the cause of public health in this country He was a man in whom the qualifications of great administrative ability, sound judgment and unrivalled knowledge of the sanitary needs of India were combined with technical attainments of a high order and a wide scientific outlook He always held that research is the foundation of sanitary progress and in this connection the Bacteriological Department the Organisation for the Study of Malaria, and the Indian Research Fund are examples of the fruits of his labours He possessed remarkable powers of critical analysis and of realising at once the true significance of problems and results, and although his official duties were arduous he always found time to keep abreast of the most recent scientific work During the periods of his leave to Europe it was his practice to study in one or other of the continental laboratories, and he was intimately acquainted with the work and writings of German and French specialists His interest in protozoology led him, when he was last on leave in Germany to undertake and almost complete the serious task of translating into English Professor Doflein s unique treatise on that subject Men of affairs sought his advice, and no research worker ever consulted him without obtaining valuable suggestions and that sympathetic and keenly interested encouragement which is an enduring stimulus to continued effort His untimely death is a loss not only to India which he served so faithfully and well, but to the world of scientists to whom at heart he belonged

EDITORIAL RECORD

In the last week of January 1911 one of the members of our Committee had an opportunity of placing on record the view that the progress of public health in this country might be greatly advanced by the establishment of a special fund to be devoted to research in connection with sanitation The idea met with the approval of the Government of India and a sum of five lakhs of rupees was set aside as an *Indian Research Fund*

The primary object of the fund is to assist the policy which for some years has been followed in India of making a direct attack upon certain of the more important epidemic diseases Research is the starting point and basis of this policy, for it has been shown not only in other countries but in India, that when the actual sources and modes of conveyance of infection have been exactly ascertained the measures which can be adopted are often far more simple and are always incomparably more effective than those recommended in the absence of this detailed knowledge The organisation proposed for carrying out the objects of the Fund is an Association consisting of permanent and temporary members, the control and management being vested in a Governing Body of which certain members will be appointed to act as a Scientific Advisory Board through which proposals in connection with the scientific objects of the Association will be submitted The proposals approved by the Governing Body will be carried into effect with the aid of Working Committees, of which the Central Committee for the study of malaria will be one It is hoped also to form committees to organise and carry on study in regard to (1) medical entomology, (2) vital statistics and the more general problems of disease, (3) cholera, (4) plague, (5) problems of practical sanitation and especially the preparation of schemes for model towns and other measures by which the efficacy of sanitation is demonstrated to the public.

The manner in which the Central Malaria Committee propose to utilise any allotment from the fund is indicated in the following report of a meeting held on the 24th May 1911

Present

The Hon'ble Surgeon General C P Lukis, C S I, I M S, *President*

Lieutenant Colonel Sir D Semple, *Kt*

Major S R Christophers, I M S

Major S P James, I M S, *Secretary*

The President desired that the Committee should place on *record a resolution expressing their deep regret at the death of* Lieutenant Colonel J T W Leslie, C I E, I M S The resolution is printed to face the first page of the present *number of these transactions*

The Secretary read a summary of the work done since the last meeting and from this the following notes containing information not already published in No 2 of PALUDISM have been extracted

Classes of instruction at Amritsar—A third class of instruction was held at the Malaria Laboratory, Amritsar, from the 15th March until the end of April 1911 The members of the class were three officers of the Royal Army Medical Corps, four of the Indian Medical Service, two Military Assistant Surgeons, six Civil Assistant Surgeons, two Sub Assistant Surgeons and a Medical Officer of Health from the Mysore State

The Central Malaria Bureau—*The collection of Indian* anopheles, in so far as examples of the different species are concerned, is practically complete A specimen of *P gigas from Assam has been received from Captain McCombie* Young, I M S, a large number of *P jeyporiensis* from

Jeypore have been added to the collection by Major Perry, I M S, and a large number of *C halli* from Assam by Major Christophers Further specimens of the new anopheles *A barianensis* caught at Simla and Murree have been received from Captain Gill, I M S, and Assistant Surgeon Quick, as well as further specimens of the new species *P simlensis* which is found to occur at Kasauli, Murree etc Numerous specimens of *N jamesii* have been sent by Dr Bentley from Bombay and some more specimens of the rarer species such as *Ne indica*, *A turkhudi*, etc, by Colonel Adie, I M S, Major Kenrick, I M S, Captain Gill I M S, and others

As regards Culicidae the following have been added since the publication of the last number of PALUDISM —

Theobaldia spathipalpis	*Stegomyia gebelensis*
Pseudotheobaldia niveitaeniata	*Howardina himalayana*
Kingia annandalei	
Desvoidea fusca	*Chrysoconops pygmeus*
„ *apicalis*	*Aedeomyia squammipenna*
Leicesteria apicalis	*Squamomyia inornata*
Stegomyia albolateralis	*Melanoconion juxtapallidiceps*
„ *W alba*	*Ficalbia minima*

Of larva eating fish the collection has received specimens of *Haplochilus* from various parts of Burma sent by Major Lalor I M S specimens of *Haplochilus* (another species) and *Anabas scandens* from Bombay sent by Dr Bentley of *Ophiocephalus* obtained from Amritsar and other species some of which have been experimented with as regards larva eating habits and others not Major Gage I M S has kindly identified a number of the commoner aquatic plants which have been placed in the collection

The thanks of the Committee are due to the following contributors to the collection —

Major W H Kenrick, I M S (many consignments), Major N P O Gorman Lalor, I M S (many consignments of mosquitoes, larva eating fish, etc), Major C B Harrison, Dr U N Brahmachari, Major F Smith, R A M C , D S O (many consignments), Sanitary Commissioner, Madras (many consignments), *Captain H W Acton, I M S, Major S P James, I M S* (Types and type examples), Captain W A Justice, I M S , Lieutenant Colonel G W King I M S (an extensive collection of Burmese anophelines and culicines), Lieutenant Colonel Castor, I M S , Dr C H Nolan, Civil Surgeon, *Prome Dr E J Murphy, Civil Surgeon, Maubin, Dr* P A McCarthy, Civil Surgeon Henzada, Prof N Annandale (named specimens of culicidae), Lieutenant Colonel C A Johnston I M S , Lieutenant Colonel T W Stewart, I M S , Lieutenant R McKie, I M S , Assistant Surgeon F Quick, *Lieutenant Colonel J R Adie I M S (many consignments),* Captain J D Graham, I M S (type examples of U P anopheles), Dr C A Bentley (mosquitoes, larva eating fish, blood films, etc), Captain C A Gill I M S (many consignments), Captain T C McCombie Young, I M S , Captain E F L L Estrange, R A M C , Assistant to the D M and S O, Nellore, Officer Commanding Bellary, Captain H C Brown, I M S , Mr R Devedathan, Major E W Hassard (several consignments), Captain A B Fry, I M S , Major McKechnie, I M S , S M O Lucknow, Major E Wilkinson, I M S , Captain G Fowler, I M S , Major R W Clements, R A M C , Dr R Keelan, Assistant Surgeon A N Quick, Lieutenant Colonel R H Penton, R A M C , Major E L Perry, I M S (several hundred anopheles, blood films, etc), Captain F A Barker, I M S , Captain R Tate, R A M C , Captain J H Horton, I M S , Major L F Smith, R A M C

Publications —The second number of PALUDISM was published in January and many *encouraging comments upon its*

usefulness have appeared in medical journals and have been received in private communications The number of applicants for copies of the publication continues to increase and it has therefore been decided that in future 750 copies instead of 600 must be printed

A new edition of James and Liston's monograph of the anopheline mosquitoes of India, which is largely the work of one of the members of our Committee has recently been published

The complete report on malaria in the Punjab by Major Christophers has just been issued as No 46 of the Scientific Memoirs by Officers of the Sanitary and Medical Departments of the Government of India It can be obtained from the Superintendent, Government Printing, India, Calcutta

Field work—Major E L Perry, I M S, is continuing his investigations into the causes underlying variations in malarial endemicity in the Jeypore Agency of the Madras Presidency It is too soon to expect definite results at present but as was anticipated, Major Perry reports that the conditions are very suitable for the line of investigation pursued It is conjectured that the increased endemicity in the hill tracts is partly a question of greater prevalence of anopheles and partly of greater poverty and inferior diet among the aboriginal hill tribes than among the people of the plains In the plains, however, Major Perry has found very curious variations of malarial intensity and it is hoped some important additions to knowledge will accrue if the causes of such variations can be ascertained An *ad interim* report by Major Perry is published in this number

Work of the Provincial Organisations—The progress of the establishment and work of these organisations was fully reported in No 2 of PALUDISM Since the issue of that number Dr C A Bentley, having finished his investigations into malaria in Bombay city, has joined his new appointment

of Special Malaria Officer in Eastern Bengal and Assam and in this province the organisation for malaria investigation is now complete It is on a larger scale than in any other province and excluding the salary of the special malaria officer the cost during the first year is estimated to be nearly 40,000 rupees The staff includes

1 special clerk for the investigation of existing vital statistics	
3 Assistant Surgeons 13 Sub Assistant Surgeons	for test enquiries into the vital statistics of selected areas
1 Sub Assistant Surgeon 1 laboratory attendant 1 tour clerk 2 coolies 1 sweeper Boatmen	for the Field laboratory and the Travelling laboratory
1 Assistant Surgeon 6 Sub Assistant Surgeons 7 Compounders	for the six Quinine Demonstration Camps which will be established
1 Assistant Surgeon 4 Sub Assistant Surgeons	extra establishment

The Governments of Madras and Burma have also submitted detailed proposals which include the appointment of special malaria officers so that with the exception of the Bombay Presidency every chief province will shortly have an officer whose sole duty is in connexion with the investigation and prevention of malaria

The following subjects were then discussed —

Arrangements for future classes at Amritsar—It was pointed out that the method by which the members of the

first three classes had been selected does not give every officer who is seriously anxious to study malaria an opportunity of joining one of the classes The Committee therefore decided that for future classes the method of selection should be similar to that now practised for the classes in bacteriology at the Central Research Institute A list of applicants will be kept and classes will be held at such intervals as may be rendered necessary by the number of candida es

Utilisation of a hoped for allotment from the Indian Research Fund —The following were considered to be the proposals which should be submitted for the approval of the Governing Body of the Indian Research Fund —

(1) *The prevention of malaria among troops* —(*a*) It was decided that in consultation with the Principal Medical Officer His Majesty s Forces in India, experiments should be made on a considerable cale for the protection of the troops in a malarious station from the bites of mosquitoes Up to the present this method of preventing malaria has received very little attention in India In order that it might be ade quately investigated two officers possessed of the requisite technical knowledge and administrative experience would be necessary The Committee thought that Captain Hodgson I M S who has just joined the Bacteriological Department from the appointment of Health Officer Simla should be one of the officers and that the Principal Medical Officer should be asked to lend the services of another

(*b*) A second investigation which the progress of knowledge shows to be urgent is a searching enquiry into the efficacy of quinine prophylaxis among troops Several thousand pounds of quinine are expended annually for prophylactic pur poses among troops in India, but the *measure* has *not yielded* such good results as were expected and the possibility that this may be due not to defective arrangements for administration, but to some other as yet unknown cause, is eminently a

subject deserving close enquiry One worker would be sufficient for this investigation

(2) *The institution of malariometric investigations* —In malaria work the need for quantitative values has become very urgent It has, for example, become absolutely necessary to arrive at some method of measuring the amount of malaria in communities more accurately than can be done by the methods now in use It is necessary to know more about the relation of numbers of anopheles to the prevalence of parasites and many other points of great importance A commencement has already been made, and one article upon the subject is published in the present number of these transactions, but such studies require the worker's whole time, and an investigator placed on special malaria duty cannot usually afford to neglect what seem to be more pressing investigations adequately to pursue this kind of work Certain determinations for practical use have, however, become almost essential to any further progress, and for this reason the Committee think it is very desirable to have at least one worker who can devote his whole time to the development of malariometric methods and their application to the study of Indian malaria

(3) *Enquiry into the bionomics of anopheles* —This enquiry, mentioned in the first number of PALUDISM, has not yet been taken up It is hoped that with the funds that may be made available it will be possible to secure the services of an entomological specialist to deal with it

(4) *Enquiry into educational propaganda* —It is hoped that it will be possible, by working in consultation with local Governments, to investigate the value of and the best way of carrying out certain proposed educational methods, including the establishment of Quinine Demonstration Camps, the rendering mosquito proof of rest houses in malarious localities, and other practical assistance in the spread of knowledge regarding prophylaxis

In connexion with these proposals the problem of obtaining workers was discussed and it was decided that the Governing Body of the Indian Research Fund should be asked to approve an endeavour to obtain from England an entomologist for the bionomical investigation and a worker recommended by Major Ross for the malariometric enquiry

The necessity for a good library of malaria literature at the Central Malaria Bureau was also brought forward, and it was decided to ask for a preliminary grant of Rs 500 for this object

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The Committee desire to direct attention to the following publications which were received too late for review in this number They will be noticed in some detail in our next issue

The pre ention of Malaria in the Federated Malay States, by Malcolm Watson, M D , with a preface by Sir Ronald Ross Published at the Liverpool School of Tropical Medicine Price seven shillings and six pence

The causes and Prevention of Malaria in Bombay, by C A Bentley, M D (Final Report) Published by the Government of Bombay

Malaria in the Punjab by S R Christophers, Scientific Memoirs by officers of the Medical and Sanitary Departments of the Government of India, No 46

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A NOTE ON SOME OF THE MEASURES THAT HAVE BEEN TAKEN TO MAKE QUININE AVAILABLE TO THE POOR IN INDIA

It is now more than half a century since the Government of India, being desirous that the people of this country should be able to obtain an efficient remedy for malaria at the lowest possible cost and being apprehensive of the extermination from their native forests in South America of the quinine yielding cinchona trees, decided to take effectual steps to procure seed and plants of the medicinal cinchonas and to cultivate them on the Nilgiri Hills and in British Sikkim The well considered measures to this end taken from 1858 to 1862 were entirely successful, and they were followed as soon as possible by the liberal distribution of seed and seedlings from the Government plantations to all applicants, with the result that in a few years thousands of acres on the hill ranges of Southern India and Ceylon were covered with cinchona trees About the same time the *Dutch Government* carried out a similar policy in Malaya, large tracts of land in Java being planted by official agency and private enterprise The ultimate results of the action taken by the Indian and Dutch authorities were to bring about a great fall in the price of quinine throughout the world and to render practicable the policy of making the drug available even to the poorest peasants in malarious countries In India the first preparation manufactured on a large scale from the bark of the Government plantations was *cinchona febrifuge*, which, at a time when the price of quinine sometimes rose as high as sixteen shillings an ounce and was on an average eight shillings and four pence an ounce, was freely offered to the Indian public at an unchanging rate of only one rupee an ounce Over 120,000 pounds of this preparation were disposed of between 1874 and 1894 Although this substitute for quinine was valuable it was clear that so long as a good commercial process for the manufacture of pure quinine was known only to certain private firms, a great and permanent cheapening of the price of that drug was hardly to

be expected The discovery by the officers at the plantation in Sikkim of an entirely new process for manufacturing pure sulphate of quinine was therefore an event of great importance, and in order to prevent a monopoly in the manufacture of the drug and to complete the efforts towards bringing about a permanent reduction of price, the Government of India in March 1888 published to the world the details of their process From 1887 to 1894 the amount of sulphate of quinine made at the Sikkim factory and distributed to the medical depôts, hospitals and charitable dispensaries all over the country was 29,761 pounds, and the amount supplied from both factories for use in various parts of India during each of the last ten years is shown in the following table:—

TABLE I

F tory	900-01	901-02	19 3-03.	9 3-04	9 4-05	905-06	906-07	9 7-08	908-09	909 10.
	P ds	P ds.	P nds	Po nd	P d	P	P ds.	P d	Pou d	Pounds.
B g l	1 00	9 733	9	1 ,0	14 865	1 733	15,78	15 957	15,550	3,8-9
Mad s	695	1 773	3 79	3 4	6 43	7 445	6,563	8 635	20 767	963
Total	21 92	2 771	2 49	27 06	3 7 3	34 20	24 3 5	5 6 1	48 353	43 964

The great benefits which have accrued to this country and to the whole world from the cinchona enterprise of the Government of India, although seldom mentioned, are universally recognised, and to India also belongs the credit of being the first tropical country in which an endeavour was made to mitigate malaria among the poor by the plan of selling single doses of quinine for the smallest coin in general daily use among the people This scheme was gradually introduced in various provinces during 1890 to 1894, the Post Office being the chief agency for the sale of the "pice packets," which contained at first five grains of pure quinine later seven grains, and in one or two provinces ten grains The following table indicates

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be expected The discovery by the officers at the plantation in Sikkim of an entirely new process for manufacturing pure sulphate of quinine was therefore an event of great importance, and in order to prevent a monopoly in the manufacture of the drug and to complete the efforts towards bringing about a permanent reduction of price the Government of India in March 1888 published to the world the details of their process From 1887 to 1894 the amount of sulphate of quinine made at the Sikkim factory and distributed to the medical depôts, hospitals and charitable dispensaries all over the country was 29 761 pounds, and the amount supplied from both factories for use in various parts of India during each of the last ten years is shown in the following table —

TABLE I

Factory	1900-01	1901-02	1902-03	1903-04	1904-05	1905-06	1906-07	1907-08	1908-09	1909-10
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Bengal	1 00	9 793	05	6 ,03	24 865	16,733	25, 80	16 957	15 596	33,8-9
Madras ...	10 485	11 5	3 70	5 4	10 45	17 445	8,545	18 855	29 757	7 985
Total ...	9	2 ,771	4 70	27 06	3 7 3	34 1/0	34 3 3	35 6 1	48,353	43 984

The great benefits which have accrued to this country and to the whole world from the cinchona enterprise of the Government of India, although seldom mentioned are universally recognised, and to India also belongs the credit of being the first tropical country in which an endeavour was made to mitigate malaria among the poor by the plan of selling single doses of quinine for the smallest coin in general daily use among the people This scheme was gradually introduced in various provinces during 1890 to 1894, the Post Office being the chief agency for the sale of the "pice packets," which contained at first five grains of pure quinine, later seven grains and in one or two provinces ten grains The following table indicates

approximately the amount of quinine sold in pice packets at Post offices during certain years from 1895 to 1910 —

TABLE II

Postal circle.	1895 96	1900 01	1902-03	1904-05	1906-07	1908-09	1909-10
	lbs	lbs	lbs	lbs	lbs	lbs	lbs.
Bengal	2114 65	1896 27	011 19	3025 81	1787 0	1303 72	1024 77
Madras	46 81	708 73	1156 99	1631 59	1744 68	1137 71	1328 86
Bombay	49 01	430 69	691 58	624 13	1367 51	1275 48	1297 47
United Provinces	?	86 30	114 38	628 0	583 51	816 27	814 54
Punjab	5 92	1 79	15 63	28 27	105 99	155 51	87 82
Cental Provinces	190 88	208 36	522 53	333 09	373 76	413 80	489 25
Rajputana	18 75	67 49	9 6	71 08	79 61		
Eastern Bengal	?	370 35	308 0	434 3ʹ	1166 34	2 0 60	426 38
Assam	37 5	67 15	78 84	67 23			
Burma	6 63	97 29	107 76	1 4 44	194 83	243 48	242 03
Total	2470 17	3954 41	5027 3	6968 2	7403 25	7548 57	7701 15

Clearly in all provinces there is still room for a great ex tension of the system, but the figures do not include the amount of quinine sold in pice packets by district officers, village schoolmasters, vaccinators and other non postal agents who in different provinces have been enlisted in this cause

Next, it should be noted that the obligation to provide quinine *gratuitously* especially during epidemic years, has not been neglected, and that of late years in addition to the large amounts supplied without charge at the numerous hospitals and dispensaries in India, the practice has been adopted of deputing hospital assistants and others to distribute the drug freely in malanous areas In the United Provinces in 1908 more than 7,000 pounds of quinine were distributed gra tuitously in the affected districts and in the Punjab about 6 000 pounds were distributed by a central agency and large quanti ties by various local bodies and organisations In Bengal in

1909 nineteen civil hospital assistants were specially deputed *to distribute quinine gratuitously* in 36 of the most unhealthy *thanas* In the Punjab during the same year 424 pounds of quinine were distributed gratuitously by 13 municipalities and 2,113 pounds by 24 district boards, large quantities of quinine were also distributed gratuitously in the North West Frontier Province

Finally, attention may be drawn to the fact that it has always been the policy of the Government of India to encourage the production and importation of quinine as much as possible and to abstain from entering into competition with private enterprise in regard to the sale of the drug in bulk In this connexion the following table, which shows the amount of quinine imported into British India during each of the last ten years, may be given —

TABLE III

1900-01	1901-02	1902-03	1903-04	1904-05	1905-06	1906-07	1907-08	1908-09	1909-10
lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs.	lbs.
61,812	43 298	6 067	5 553	63 648	63 9 3	71 237	81 073	80 020	120 112

The total consumption of quinine in India may be ascertained by adding these figures to those already given in Table I, and it is of interest to place the results alongside those for Italy —

TABLE IV —*Total consumption of quinine*

	1900-01	1901-02	1902-03	1903-04	1904-05	1905-06	1906-07	1907-08	1908-09	1909-10
	lbs.	lbs	lbs.	lbs	lbs	lbs.	lbs.	lbs	lbs.	lbs.
India	8 104	65 069	83 106	8 924	100 3 1	103 152	1 5,5 5	117 621	128,373	15 9 5
Italy	[illegible]	[illegible]	3 454	44,4 8	60,142	71 474	3 445	83 0	3,2,0	0,000

It will be seen that the consumption of quinine in India is increasing steadily and that the rate of increase compares favourably with the rate of increase in Italy

The further measures which are now being taken in several provinces for bringing quinine within reach of the poor in India will be the subject of subsequent notes

(*S P J*)]

ON THE SELECTION OF UNIT AREAS FOR RECORDING DATA CONCERNING MALARIA IN INDIA

(*With map of India*)

Much thought and enquiry have been devoted to an attempt to form subdivisions of India, which, being homogeneous in regard to malarial conditions, as far as we know them, are suitable as units for recording on broad lines certain data concerning malaria in India

The attempt has resulted in an arrangement which is practically identical with that already in use by the Indian Meteorological Department, the names, position and extent of the areas being shown on the accompanying map which has been *reproduced from one of those in use by the Meteorological Department* The present note is intended to draw attention to the main features of the plan of subdivision shown on the map and to indicate the suitability of the divisions for recording information about malaria

The subdivision at first sight may seem too detailed, but it must be remembered that on an average each of these subdivisions is many thousand miles in extent and that it is not likely that any larger division will give us the homogeneity we desire Again, it may be thought that the subdivisions are so large as to lack this quality of homogeneity, but it is safe to say that though we know a good deal regarding malaria in many of them, in regard to others there is scarcely a single observation, so that for the present the question of further subdivision hardly arises

In selecting our units for malaria work, it is desirable that within certain limits we should be guided by the following considerations —

(*a*) Large differences of geographical position such as may influence the distribution of species of anopheles

(*b*) Physical characters

(*c*) Rainfall and climatic conditions generally

(*d*) Economic features, notably the nature of the staple food crop

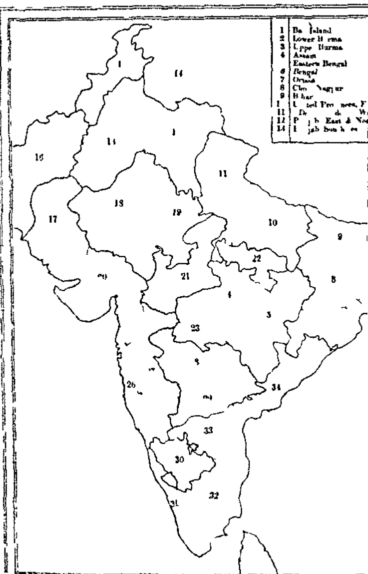
(*e*) Marked racial characters

It is also very important to make the boundaries of the subdivisions correspond with boundaries of provinces, the limits of districts, and so on, the object of course being that we may more readily make use of vital statistics and other information collected according to administrative areas

Geographical—India has been divided from a broad and general point of view into three main geographical areas* The Himalaya, or abode of snow, the Middle Land, or Madhyadesa, and the southern table land of the Deccan To these must be added Baluchistan and Burma

Physical features—The most convenient guide to the physical features of India is the course of the 1,000 feet contour line Starting from near the sea coast at Chittagong to end near Karachi on the west the 1,000 feet contour line can be followed, first, to the north, separating the highlands of Burma from the plains of Middle India, then to the north west in a line of some two thousand miles, separating off the Himalaya, and finally, to the south, delimiting the eastern border of Baluchistan South of the plains of Madhyadesa we again meet with altitudes of over 1,000 feet, and we can follow a second line which, starting on the east near the mouths of the Mahanadi, extends across India to end near Surat on the west In its course this line separates Middle India from the Deccan The first line in its passage along the foot of the Himalayas shows scarcely any irregularities of importance, nor does it as a rule pass to any extent up any of the river valleys The second line is not so regular, and we have to

* Report on the Census of India, 1901, page 5



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notice especially a disturbance due to the valleys of the Chamba and Betwa south of Agra, and those of the Narbada and Tapti east of Surat

The two lines we have followed with the coast line at the mouths of the Ganges and Indus form the boundaries of what we have so far called Middle India This is a vast alluvial plain of remarkably uniform character extending in a broad belt from the borders of Baluchistan to those of Burma Upon it live nearly half the inhabitants of India

To the south of the second line lies the Deccan To examine this more closely we may again follow the 1,000 feet contour line Passing along the west of the Indian Peninsular, this line, for all practical purposes coincides with the sea coast On the east again it hugs the sea coast as far south as the Godavery river But from this poi t to the extreme south of India there is a comparatively broad strip of plains land Here too as in the case of the Chambal river the valleys of *the Mahanadi Godavery Kis na P re an I Cauvery cause* large disturbances in the line and of the we shall have to take notice The strip of plain referr d to though on a much smaller scale than the vast plain of Midd' India is with its tributary valleys, the second most extensive area of plains land in India

The remaining portion of the Deccan consists for the most part, of land of moderate elevat on by no means entirely above the influence of malaria and sometimes even characteri ed by a peculiar intensity of this disea e The chief components of these Deccan Uplands are (*a*) the Malw plateau and Aravalli range, which perhaps we should not except fo the sake of uniformity, have included in the Deccan, (*b*) the Pachmari and Mahal Hills, (*c*) Chota Nagpu fo m ng a no them plateau (*d*) what we may call the Jeypo e Hill Tract forming an isolated plateau inland from Vizagapatam, (*e*) the basalt

plateau of the Bombay Ghats, (*f*) the gneissic plateau of the south portion of the Peninsular In this last division only are there areas of any size (Nilgiris, Anaimalis, Pulnis) above the influence of malaria

Rainfall—The total annual rainfall of India has a very definite distribution The most striking features are—

(*a*) An area of deficiency in the north west, which we may map out by following the limit of an annual fall of under 20 inches

(*b*) Two areas of very heavy rainfall—one over Eastern Bengal and Assam, and the other a narrow strip in which the rainfall is 75 inches or over along the western coast

(*c*) An area of more moderate rainfall over Bengal and the north east of the Deccan (50 to 75 inches), extending over much of the United Provinces (40 to 50 inches)

(*d*) A broad belt extending from north to south, in which the rainfall is between 20 and 40 inches

Staple food crop—For reasons which have become very evident in the course of recent researches, consideration must be given to the main economical features of the different areas For the present it is not proposed to do more than draw attention to three types of areas, which may be called respectively Rice, Wheat, and Millet areas Without entering into the reasons for such definitions, we may define a rice area as one in which rice forms over 25 per cent of the total cropped area, a wheat area as one in which rice forms less than 25 per cent and wheat or maize forms over 25 per cent of the total cropped area, and a millet area as one in which neither wheat nor rice forms 25 per cent of the total cropped area and in which *Bajra* or *Jowar* is the staple food Roughly speaking

rice cultivation on any scale commences rather abruptly at a line which, corresponding with the limit of 30 inches total annual rainfall, starts at the Himalayas about the centre of the United Provinces and passes in a semi circular sweep across India to Surat There is a large tract, however, not included within this limit which owes its origin to irrigation from the Indus (Sind) Wheat areas are confined to the parts excluded by the semi circular rice line referred to (Punjab, western half of United Provinces northern portion Central Provinces) Millet areas take the place of wheat where the soil is poor and of rice areas where irrigation or rainfall is insufficient for this latter crop

Race—Of race we need say comparatively little The most important features from our present point of view are the following —

(*a*) Races inhabiting the plains of Northern India from the Indus almost to Calcutta for the most part living in compact villages of mud built houses

(*b*) The races of lower Bengal and the rice countries to the east living for the most part in small scattered hamlets of bamboo built houses

(*c*) The aboriginal races of Chota Nagpur, Central India, and other parts of the Deccan

(*d*) The Marathas of the North west Deccan

(*e*) The Dravidian races of Southern India

Natural divisions as defined by Sir John Elliot—Before giving our final classification of areas some mention must be made of what may be called the authorised natural divisions of India These were drawn up by Sir John Elliot in 1901 and are as follows —(1) Baluchistan (2) North West Dry Area, comprising the plain of the Indus and including Sind, the

Total annual rainfall 50 to 75 inches	(9) Bihar Rice forms 60 per cent of total cropped area. (6) Bengal Deltaic region Rice forms 80 per cent or over of total cropped area Bengali race
Total annual rainfall over 75 inches	(5) Eastern Bengal Annual flooding of large tracts Rice 80 per cent or over Bengali or allied races (4 a)* Assam Brahmaputra valley
Peculiar geographical position and physical features	(20) Gujarat

III — DECCAN MOSTLY OVER 1,000 FEET BASALT (DECCAN TRAP) AND GNEISSES

A — Total annual rainfall under 50 inches Eastern Plain under 1,000 feet	(32 a)* Madras South East Carnatic plain Tanjore, Coimbatore, etc (32 b)* Madras Hills Nilgiris Pulnis, etc (34 s)* Madras Coast North Portion of the area south of the Godavery Godavery, Kistna and Nellore districts
River Valley Plains for the mo t part under 1,000 feet	(25) Orissa. Contains much flat land (Valley of) Rich ri

* In the e areas further meteoro

* Central Indian Plateau	(19) Rajputana East (21) Central India West
* East Satpuras (Plateau)	(22) Central India East (24) Central Provinces West Wheat area
* Deccan (Plateau)	(28) Hyderabad North (Native State, contains upper portion of Godavery valley) (29) Hyderabad South Native State (27) Bombay Deccan Receives more rain than rest of the plateau
South India	(33) Madras Deccan Cuddapah, Kurnool etc (30) Mysore (*Native State*)
B — Total annual rainfall 50 to 75 inches	
Chota Nagpur Plateau	(8) Chota Nagpur Aboriginal races Rice area.
Jeypore Hill Tract	(34 N) Madras Coast North Area now being investigated with reference to study of endemic malaria.
River valley plains for most part under 1,000 feet.	(*25*) *Central Provinces East* Contains valleys of Godavery and Mahanadi
C — Total annual rainfall over 75 inches	(26) Konkan Bombay Presidency (31) Malabar Madras Presidency

IV — Burma (*S.R.C.*)

* Names are those of Sir John Eliot's Natural Divisions of India.

THE EFFECT OF ENDEMIC MALARIA UPON THE BIRTH AND DEATH RATE

BY

W H KENRICK,

Special Malaria Officer, Central Provinces

In both its endemic and epidemic forms malaria has a very marked effect upon the birth rate

In the case of epidemic malaria, a great reduction occurs in the total number of births in the year following the epidemic This reduction begins in the month of March or April, *i e* nine months after the commencement of the fever season, and is greatest in June or July, the ninth month after the epidemic is at its height Corresponding with the subsidence of the epidemic, the birth rate gradually recovers and may even exceed the normal These features are well shown by the figures given below which represent the births in two areas in the Punjab and in the Damoh District of the Central Provinces for the year 1909 following the severe epidemic conditions of 1908 For the district of Damoh, which is a portion of the Central Provinces subject to epidemic malaria, are given also the births during the five normal or but slightly affected years 1904 1908, those for 1903 following moderate epidemic conditions, and those for 1901 following the famine year 1900 —

	Amritsar	Delhi	Damoh			
	1909	1909	1909	1904-1908	1903	1901
January	2 50	1,8 0	1 1 0	1,550	1 350	50
February	3 0 0	1 700	800	1 0	800	500
Ma ch	3 00	1 400	830	1 00	1 000	453
Apr l	2 50	1,200	900	1,5	1	00
M y	1,000	700	7 0	1 400	1 100	00
J	1 100	400	500	1 3 0	1 000	500
July	1,000	80	550	1 350	900	653
Au t	1,500	1 600	75	1 00	9 0	50
S p ember	3 1 0	1 300	9 0	1 60	1 100	950
October	4 100	3 800	1 250	1 0	1 300	350
November	6 00	3 100	1 2	1 300	1 600	1,250
December	4 00	3 200	1 500	1 35	1 0	1,400

NOTE —F e planation of the t ms endem c and epid m c mal a and the mea n f the word healthy hyper ndemic etc *vide* memora d m by th Central Comm tee given PALUDISM I p ge II A heal hy ea s the d fined a wh h the spleen ra e am ng chil en is not ab ve o p c t a mod at ly d mic a ea a ne n wh ch th ra e l bet een to a d 2 per ce t a h ghly ndemic a a in which the ra between 2 and 50 per cent and a hype -endemic area as one n which the rate is over 50 per cent.

Endemic malaria, on the other hand may have, as will be shown no effect upon the yearly rate, the birth rate for the year in highly endemic areas in the Central Provinces being as high as that in healthy areas It has a marked effect, however, on the monthly distribution rate

To show the absence of effect upon the total birth rate, I give the the birth rates of two groups of villages in which the amount of malaria was determined by actual measurement The first group which I shall call ' healthy villages com prises 34 villages in the plains of Balaghat district, having a combined population of 19 064 and a spleen rate, as shown below, of 4 per cent

Spleen rate of 34 "healthy" villages (Lalburra and neighbourhood)—

No of children examined	Class I spleen to umbilicus	Class II Hand breadth	Class III Two to three fingers	Class IV Palpable	Class V Negative
727	3	3	6	18	697

Total percentage with enlarged spleen, 4 per cent

The second group, which I shall call "Hyper endemic" villages, consists of 33 villages having a combined population of 10,825 and an average spleen rate as shown below of 80 per cent

Spleen rate of 33 "Hyper endemic" villages (Chichgarh, Pallandur, Bijagarh, etc)—

No of children examined	Class I spleen to umbilicus	Class II Splee Hand breadth	Class III Spleen two to three fingers	Class IV Splee Palpable	Class V Negative
840	8	173	37	217	165

Total percentage with enlarged spleen, 80 per cent

The following table contrasting the birth rate of these two groups for a period of three years shows that endemic malaria, even in a hyper endemic tract, has not had any effect upon the total birth rate per mille of population living —

	Spleen rate	Birth rate, 1908	Birth rate, 1909	Birth rate, 1910
34 Healthy villages population 18,064 ..	4%	43	49	45
33 Hyper-endemic villages population 10,825	80%	44	42	48

Monthly distribution rate.—Though endemic malaria does not influence (so far as observations have gone) the total birth rate, it has a marked effect upon the monthly distribution of births. If the monthly birth curve of a healthy area for a series of normal years is drawn, it is seen that the births are fewest in number during the early months of the year and greatest during the autumn months, the curve reaching its maximum in October or November. This feature of the curve is practically constant, provided abnormal years, such as those characterised by epidemics, scarcity, etc., are excluded. It is well shown in the series given below which gives the births in certain non-malarious parts of the Central Provinces:—

Average births for the seven yearly period 1903-1909 in certain non-malarious thanas of the Central Provinces.

	Amgaon	Hata	Baraghat.	Lakhal.
January	770	870	670	710
February ...	620	7 0	520	630
March	590	750	530	690
April	810	800	560	[illegible]
May ...	0	750	550	670
June	710	750	500	640
July	730	600	570	[illegible]
August	900	1 030	[illegible]	[illegible]
September	1 000	1 100	9 0	970
October	1 050	1 230	1,070	1,000
November	[illegible]	[illegible]	920	850
December	940	900	730	830

The probable reason for this distribution is that the early part of the year, being the most healthy and at the same time the period of the harvest when the physical and material condition of the people is at its best, is the period most favourable for conception.

In a malarious locality on the contrary the early months of the year are those in which the results of fever are most evident In every hyper endemic area visited the people were unanimous in saying that the worst time for fever is the cold weather, *viz* from December to March And here, just as happens in epidemic malaria, a period of increased fever prevalence seems to be a period of comparative sterility, for the rise in the birth curve, which should normally occur in the autumn, is postponed for three or four months and takes place instead during March, April or May In malarious areas, then, the period after the end of the fever season, *viz* June and July, is the most favourable for conception

The character of the birth curve in malarious areas is well shown in the following table, which gives the average monthly births for a number of hyper endemic areas —

Average births for the seven yearly period 1903 1909 in certain hyper endemic thanas of the Central Provinces

	Rupsar	Bir.a	Baihar	Chichga b
January	280	430	400	210
February	2 0	400	4.0	210
March	250	440	460	250
April	400	6 0	6 0	340
May	330	750	620	3 0
June	310	640	600	350
July	2°0	630	5 0	270
August	3"0	640	520	290
September	310	550	550	290
October	270	510	510	2 0
November	280	4 0	430	260
December	230	360	420	40

The lower the degree of endemicity of any place the more closely does the birth curve approximate to that of "healthy" areas

Effect of endemic malaria on the death rate.—In hyper endemic as contrasted with healthy areas, there is an increase in the total death rate It is also noticeable that in hyper endemic villages there is a proportionately greater mortality among infants and children 2 to 3 years old

During the course of my investigations (cold weather), I saw many children suffering from fever, and on more than one occasion I saw a fatal termination to an uncomplicated attack of malaria in a child

The history of such a case is as follows An apparently healthy child has an attack of fever lasting seven or eight days in November or December The child is then quite well for two or three weeks until another bout of fever supervenes followed by another apyrexial period The relapses now occur at more frequent intervals and with greater severity As quinine is practically unknown to these people unless the child acquires a certain degree of immunity death occurs, very often with cerebral complications In one such case which came to my notice a well nourished child had been unconscious for four days with high temperature and convul sions There was no enlargement of the spleen but blood films taken half an hour before death showed an average of 12 quartan parasites (large and small) per microscopic field whilst crescents were on an average 3 per 100 fields

Deaths of children in malarious areas constitute from 55 to 65 per cent of the total mortality which is very nearly double the percentage found in non malarious localities In the village returns practically every death is ascribed to fever From personal enquiry into the causes of 300 deaths in hyper endemic centres I find that in nearly half the deaths the cause of death is correctly returned for while in the case of adults this diagnosis of fever is mostly wrong, in the case of children it is most often right

If malaria causes death in an adult, it is generally indirectly A frequent cause of death among adults in hyper endemic areas is cirrhosis of the liver with oedema Another common cause is some lung complication supervening upon an attack of malarial fever

With children it is the intensity of the parasitic invasion that kills, and most of the deaths are correctly ascribed to "fever"

The extent to which a high degree of endemic malaria affects the death rate can be gathered from the following figures which contrast the death rate in the 34 healthy villages previously mentioned with that in the 33 hyper endemic villages —

		1908	1909	1910
34 healthy villages Pop 18 064	Spleen rate 4 per cent	24	2	33
33 hyper-endemic villages Pop 10 8 5	80	38	32	44
3 highly endemic villages Pop 5 02	36	29	28	40

In the last entry in the table is given the death rate per mille per annum of three highly endemic villages having a combined population of 5,022 and a spleen rate of 36 per cent In none of these villages was there plague or cholera during the years given

From the facts stated, it is reasonable to assume that malaria in hyper endemic form causes in the Central Provinces an increase of from 10 to 15 per mille in the death rate

Curves giving the monthly deaths in malarious localities show that the smallest number of deaths takes place as a rule in July, whilst the largest number occurs at the end of the rains and during the cold weather

Effect of endemic malaria on the natural increase of population—While the total population of the Central Provinces has increased considerably during the last decade, it is mainly in the non malarious localities that this increase has occurred On the whole the hyper endemic villages show a very slight increase while very many show a decrease

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INFECTION AMONG TROOPS AND NATIVE CHILDREN AT DELHI

BY

J R ADIE,

Special Malaria Officer, Punjab

The following notes throw some light on the amount of malaria among troops, especially the extent to which latent and concealed malaria may prevail By a case of concealed malaria is meant one in which a soldier, though ill, does not report sick, either on account of some pecuniary loss he may suffer or from a high sense of duty

The figures relate to British troops living in the Fort at Delhi and native children living either within the Fort or in the immediate neighbourhood (Daryaganj) Delhi Fort is notoriously unhealthy and both the British troops within the Fort and the Native infantry at Daryaganj are heavily infected each year with malaria The fever season in this part of India being at its height in October and November, the figures for British troops probably represent the highest degree of infection for the year 1910, those for the children taken at the end of September represent the condition of affairs at or near the commencement of the fever season

British troops—In order to get as complete material as possible for my estimation, I took advantage of a quinine parade which was being held at the Station Hospital by Major Brown and Captain Brown, R A M C, to both of whom my thanks are due On 11th November 1910, in the morning, all men not in hospital or actually engaged in duties being paraded, I took a film from each In all 160 films were taken and of them 10 were accidentally spoilt The remaining 150 were very carefully examined by me and the parasites recorded by a convenient method for indicating approximately the numerical prevalence

Examining in most cases 100 fields, 38 of the 150 or 25.3 per cent showed parasites. Given in extended form the results were as follows: *the numerator being the number of* fields examined and the denominator the parasites found —

[illegible]

NOTE.—Cr = Crescents. MTr = Malignant Tertian Rings. BTr = Benign Tertian Rings.

Of the 38 infections 33 were therefore malignant tertian and 24 of these were crescent bearing cases. Only 5 were *benign tertian. Considering only those cases in which gametes* were actually found in 100 fields nearly a quarter of the men actually carrying on their duties were gamete carriers. If a more complete examination had been made it is almost certain that a larger proportion of infected men and crescent carriers *would have been shown.*

As a demonstration of the extent to which inadequate samples may affect malaria determinations I may note that —

In the 1st group of 30 films examined there were	3 infections	or 10 per cent.	
" 2nd " " " " "	11	" or 36	"
" " 3rd " " " " " "	11	" or 36	"
" " 4th " " " " " "	6	" or 20	"
" " 5th " " " " "	7	" or 23	"
In the whole community (150 films) there were	38	" or 25	"

Anopheles at the time were abundant, especially *P. rossi. M. culicifacies, My. barbirostris* and *My. sigerrimus. N. fuliginosus, C. pulcherrima, Ne. ?ceylonensis* and *N. maculipalpis* were present, but not abundant.

Native children.—On the 26th September, 53 films from the children of followers living in the Fort itself were taken

The percentage showing infection in the examination of 100 fields was 43 4 Given *in extenso,* the finds were as follows —

$\frac{5}{BT\ \&\ Gam}$, $M\frac{5}{Tr}$, $\frac{5}{BT\,Gam}$, $\frac{1}{c\ 5}$, $\frac{}{10\,BTr}$, $\frac{3}{}$, $\frac{}{3\,BT}$, $\frac{}{3}$, $\frac{}{6\,BT\ \&\ c}$, $\frac{}{6\,BT\ p\ \ g\ \&\ G\ m}$, $\frac{1}{4\,BT}$, $\frac{5}{3\,BT}$, $\frac{50}{5\,BT}$, $\frac{1}{4\,B}$, $\frac{}{3\,BT}$, $\frac{}{1}$, $\frac{15}{1\,MT}$, $\frac{5}{}$, $\frac{}{}$, $\frac{}{}$, $\frac{5}{7\,BT}$, $\frac{5}{BT\,G\,m}$ $\frac{30}{1\ \ 1}$,

It will be noted that in this case there were 12 benign tertian infections *to 10 malignant tertian infections* and one case in which both types of parasite were present

On 12th January 1911, eighteen children of the same community were examined, six, or 33 per cent, showed parasites

At Daryaganj (adjoining the Fort to the south) 24 children of the 33rd Punjabi sepoys were examined Parasites were found in 19 or 37 5 per cent Given in detail the results were as follows ——, $\frac{5}{BT}$, $\frac{5}{}$, $\frac{3}{BT\,G\,m}$, $\frac{}{BT}$, $\frac{100}{BT}$, $1\,P\,\frac{50}{g}\,BT$, $\frac{2}{2}$, $\frac{}{BT\,G\,m}$

It is necessary perhaps to say that both the British troops and the children of the followers were under prophylactic quinine treatment—the former by means of quinine parades, the latter through the agency of a Sub Assistant Surgeon To what extent the 45 grains weekly were actually consumed by the individual soldier or how far the apparent failure of quinine to prevent the occurrence of parasites in the blood represents real inefficacy of the drug, I am not prepared in the absence of investigation to say

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MALARIA IN THE JEYPORE HILL TRACT AND ADJOINING COAST LAND

BY

E. L. PERRY
On Special Duty

Observations were commenced in January on the coast at Vizagapatam. In the main part of Vizagapatam town the spleen rate was found to be only 2 per cent. A focus of severe malaria however was found on the far side of the Vizagapatam Harbour. The near side of the harbour was also affected though in a lesser degree, the evidence of the prevalence *of malaria disappearing very rapidly as the main part of the town* was approached. Anophelines were found breeding abundantly throughout the residential portions of Waltair (European quarter of Vizagapatam) in the adjacent parts of Vizagapatam and in the surrounding villages.

At Bimlipatam 16 miles further along the coast the spleen rate was *nil*, 100 children being examined without any case of enlargement of the spleen being encountered. There was a great deal of water about and anophelines were found breeding freely.

The following species of anophelines were taken in the Coast Tract:—*M. culicifacies, N. fuliginosus, N.* [illegible] *A. rossi, Ne. stephensi, My. nigerrimus.*

In February work was commenced on the Jeypore Plateau (3,000 feet) where malaria is reported to be very severe. The spleen rate was found to be 75 per cent. Blood specimens were obtained from 15 villages, 13 of which were at an altitude of 3,000 feet and 2 at an altitude of 2,000 feet above sea level. The total number examined was 351. Of these only 4 were taken from persons over 15 years of age. The

majority were from the children of aboriginal races (*Parasas, Gadabas,* and *Doms*), who so far as is known have occupied these regions from very remote times The time within which the films were collected was from 11th February to 20th April Of the 351 specimens 217 showed malaria parasites giving an endemic index of 61 per cent Of the total number examined 29 per cent had rings (diagnosis not certain but mainly quartan), 16 per cent undoubted quartan, 13 undoubted benign tertian, and 3 per cent crescents In 14 cases benign tertian and quartan were found, in three cases benign tertian and crescents, in three cases crescents and quartan, and in one case crescents, benign tertian and quartan

Every specimen was searched for ten minutes, the results in regard to the numerical value of the infections being as shewn in the table —

Number of parasites seen in ten minutes	*Nil*	1 to 5	6 to 15	16 to 30	Over 30
Number of cases	124	104	65	23	25

In order of frequency, the types of parasite present were, as *already mentioned, quartan, benign tertian and malignant tertian* Quartan is also the most active fever, at any rate during the spring months when these examinations were carried out The latter point is evidenced by the fact that when a quartan infection is found, the parasites are present in considerable numbers and sexual forms are frequent It is also evidenced by the fact that at this season of the year primary infections among new comers are usually quartan

Wherever search has been made abundant breeding places of anopheles have been found, and in all the villages visited

adult anopheles have been collected So far, the following species have been found in this tract —*M culicifacies M listoni P jeyporiensis N fuliginosus N theobaldi N maculipalpis*, *Ny rossi*, all these have been present from the beginning of observations with the exception of *Nyssomyzomyia rossi* which at first could not be found but has since appeared and become abundantly prevalent

In March and again in May a series of dissections of anopheles, mainly *M culicifacies* were made On both occasions at least a hundred glands were examined but with negative results On both occasions the weather was very dry, and on the latter occasion the maximum day temperature was 98°I in the shade

Most ample assistance has been rendered to the work of investigation by the Special Assistant Agent and the officers in the Jeypore Agency

THE RELATION OF THE ENDEMIC INDEX TO THE SPLENIC INDEX IN EPIDEMIC AREAS OF THE PUNJAB

BY

E L PERRY,

On special duty

On page 44 of PALUDISM No I for July 1910 is a table detailing the endemic and splenic indices of some villages near the Chenab River in the Gujrat District The figures were ascertained shortly after the great epidemic of the autumn of 1908 In April 1910 these villages were again visited and blood specimens obtained from 78 children For these 78 children the splenic and endemic indices were respectively 59 per cent and 27 per cent On referring to the above mentioned table it is evident that since June 1909 the endemic index has decreased in greater degree than the splenic index Moreover in the films from infected children the parasites were far less numerous than at the previous examination

The relation of crescents to other parasites at the two periods is most important In December 1908 at the decline of the epidemic, when the endemic index was 75 per cent crescents were present in 25 per cent of the total number of children examined At this time benign tertain sporonts were far more frequently met with than crescents In June 1909 at the dryest and least malarious part of the year the endemic index for the same community was 71 per cent and crescents were present in 17 per cent of the total number of children examined In April 1910 the figures were respectively 27 per cent and 6 per cent On this occasion out of the 78 bloods examined only two were found to contain benign tertian sporonts and no benign tertian schizonts were seen In the community therefore as in the individual the malignant tertian parasite dies harder than the benign tertian

A HANDY METHOD OF COLLECTING ADULT ANOPHELES

BY

J R ADIE,

Special Malaria Officer, Punjab

(With plate)

The usual method of collecting adult anopheles for dis section is to transfer them one by one as they are caught in test tubes to a large bottle or jar the mouth of which is either plugged with wool or is covered with a paper cap in which a hole has been cut Much time is occupied in this procedure in making the mosquitoes fly from the tube into the bottle and, unless one is very careful pieces of wool are apt to fall into the jar, the paper cap to become torn, and so on The follow ing method has many advantages and is free from the above mentioned defects —

Outfit —The following only are required —

I —A lamp glass prepared as shown in the diagram Over one end is stretched tight and tied in posi tion a piece of rubber sheet in which a slit just large enough to admit the end of the tube you are going to use for catching the mosquitoes has been cut A short length of old bicycle tyre serves admirably for this purpose (Fig A)

II —A test tube in the bottom of which three or four holes have been drilled with the aid of a writing diamond, or a test tube the bottom of which has been removed, or a suitable length of glass tubing over the end of which a piece of muslin has been tied (Fig B B)

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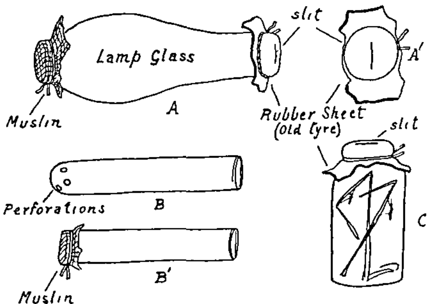
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I System of mounting etc C M Bureau

d
v
head removed by slanting cut
l
254
A
cork
B
slide
C
D
E
wedge shaped piece cut out of Cork
Cork sheet
cork of tube
F
F′
cork sheet
Tube 3 x 1″
pin
Bottom holding cork in place
Cardboard Box
cork sheet
Lid
G

II Adie's apparatus for collecting adults



A SYSTEM OF MOUNTING, EXAMINING, AND PRESERVING MOSQUITOES

Central Malaria Bureau

(With plate)

In dealing with different kinds of material at the Bureau some extension of the method of "mounting mosquitoes" as ordinarily understood has been found necessary The basis of the mounting system is the use of a fine pin from which the head has been removed *by an oblique cut* with a sharp pair of scissors The object of making the cut obliquely is that by this means the pin is made sharp enough at the head end to penetrate cork etc readily A pin truncated by a transverse cut can be pushed into cork but not readily and it easily falls out, a pin with an obliquely cut end engages the cork with ease and certainty

The full system at present adopted is as follows —

I—Mounting mosquitoes as dried specimens—(*a*) If a well arranged specimen is desired, the method of preliminary mounting on a card is still employed, as this enables the legs and abdomen to be kept in good position The arrangement, however in this case is not necessarily final and, there being no head to the pin the specimen can at any time be withdrawn, pin and all from the card the presence of which of course entirely precludes any examination of the ventral surface of the mosquito When employing this method the usual procedure is adopted (*vide* Instructions to Collectors), but the precaution is taken to drive the point of the pin about the eighth of an inch through the back of the dorsum by pressing against a *smooth* cork surface It has generally been taught that a card *circle* should be used, but a *square* is much more readily cut, and so far as is known there is no particular advantage in a circle

(*b*) The above, which is the method of mounting ordinarily taught, is used only because it makes good museum specimens Ordinarily it is sufficient merely to impale the *mosquito with a fine headless pin without any cardboard at all* (*Vide* Fig B) In this case after the mosquito has been transfixed and the point of the pin made to project a little beyond the back of the thorax, the thicker end of the pin is driven into a small strip of cork (Fig E) or a block of pith (Fig D) or stuck, along with similarly mounted mosquitoes, on a piece of cork sheeting (Fig G)

II —Examination of dried specimens —If a specimen has been mounted on a card, it is, as a rule, left in this condition until it becomes necessary to examine it It is then removed from the card and treated in the same way as specimens mounted simply on a pin For examination of a mosquito under the microscope one may use a sheet of cork *moved over the stage of the microscope by the fingers*, or more conveniently a small strip of cork about the size of a slide which is placed between the arms of the mechanical stage and moved about as though it were a slide, or still better perhaps an oblong strip of cork 2" by 1" placed upon a glass slide which is then manipulated by means of the mechanical stage In all these cases, however, it is difficult to arrange the mosquito suitably for examination from certain points of view One of the most convenient of all methods of examination is to use a stout *cork (the cork of a 3" by 1" specimen* tube) which is placed upon a slide and manipulated with the mechanical stage For examination of the dorsal or ventral surface the upper surface of the cork is used, for lateral and certain other views the pin of the mosquito is stuck at various angles into the sides of the cork (Fig C)

III —Remounting after examination —It is obvious that a specimen after examination is easily remounted either singly on a pith block (Fig D) or on a cork strip (Fig E) or along *with other specimens in store tubes* (*Fig F*)

IV —Preservation of mounted specimens—

(*a*) *Permanent preservation of a single specimen* —Either on its original card or on a pith block the large pin of the specimen is driven into the inner side of the cork of a specimen tube 3" by 1" Before doing so however, a wedge shaped piece is cut out of the cork as shewn (Fig F) The name or catalogue number is then written on the outside of the cork and the tube is placed over calcium chloride in a dessicator for three or four days In practice a jar is used capable of holding say a couple of dozen tubes and specimens are allowed to accumulate in this until it is full After the most recently added tubes have remained for the required time in the dessicator all are removed and at once sealed with paraffin, the hole in the cork being first lightly plugged with a little pledget of wool to enable the paraffin to close the opening Each tube is then rolled in a small square of wool which is tied on with a short length of tape The number on the cork can always be seen without removing the tube from the wool and the specimens can be handled with the greatest freedom without any danger whatever of jars or knocks which are a fertile source of damage when storeboxes or unprotected tubes are used

(*b*) *Permanent preservation of numbers of mosquitoes* — When it is not desired to give a whole tube to a single specimen a tube is prepared as shown in Fig F A strip of thick cork sheet is cut $2\frac{1}{4}$" by $\frac{1}{2}$ or slightly less A wedge shaped piece is cut out of this near one end and by means of a stout pin the strip is fixed to the inner surface of the cork of the specimen tube (from which a wedge has been cut as before) near a portion of its circumference (Fig F) As many specimens as convenient are now pinned on to the strip by sticking the sharpened head end of the pins into the cork strip The outer surface of the cork of the tube being labelled and the tube placed in the dessicator for a period, this is finally sealed and wrapped in wool

Treated in this manner mosquitoes are for all practical purposes permanent preparations When the tube is opened to allow of the specimen being examined microscopically and the mosquito is being replaced the plug of paraffin and wool is removed and the specimen left for a period in the dessicator jar This, if done as a routine, is no trouble, since a jar is always kept at hand in which tubes can be placed until one has leisure to reseal them

V—Despatch of specimens—The preceding method of mounting is very convenient for the despatch of specimens If two or three mosquitoes only are being sent they can be stuck directly into the cork of a *specimen tube or twenty or so can* be put up on a cork strip in a tube on the "telegraph pole" system (Fig F) Dealing with larger numbers it is convenient to use a cardboard box into the lid of which a piece of cork sheet has been fitted On closing the box the cork will be *held firmly in* position so *that no further fixation is* required (Fig G)

It is very easy to mount mosquitoes in this way without any trouble about card discs, etc, and a hundred may easily be put up at a sitting A hundred mosquitoes can be packed so put up, in a single quarter plate photographic slide box o in five or six tubes

VI—Manipulation of dried unmounted specimens—Many specimens are received at the Bureau loosely packed in wool When it is desired to examine such in detail or to preserve them they are placed for an hour in a moist chamber After *this they* can be transfixed with a fine headless pin and of course at once examined or mounted in any way desired

VII—Permanent potash preparations—Whenever possible, in addition to dried specimens of a species, balsam mounted potash specimens are prepared * It is often a good plan

* These and some further points of technique will be given in future numbers of Paludism

only to do in the field the necessary boiling in 10 per cent potash and subsequent washing and to preserve the specimens in 70 per cent alcohol for future mounting

VIII.—Larval and nymphal stages.—The larval and nymphal skins of adults which are actually preserved and catalogued in the collection are alone employed for descriptive work. Fortunately it is found that such skins make even better preparations than the actual larva or nymph.

NOTES ON MOSQUITOES

I.—A method of keeping adult anopheles alive without feeding them on blood.—Lieutenant Colonel J. R. Adie, I.M.S.—Under ordinary circumstances all anopheles caught and kept in tubes or bottles die in at most two or three days if not fed on blood. By a very simple procedure I have been able to keep anopheles adults alive without feeding them on blood for as long as three weeks.

In an ordinary jar or lamp glass containing anopheles are placed (*a*) a dried date wrapped in a small piece of muslin, (*b*) a small fragment of wet sponge, (*c*) a twig of some green weed the end of which is stuck into a hole in the sponge. In a jar so prepared anopheles live for a long time.

If examples are required for dissection a clean jar is placed upside down over the mouth, the muslin is removed, the lower jar covered with a cloth to render it comparatively dark and a few taps made with the lower jar on the table. The anopheles will fly upwards into the fresh jar.

II.—M. listoni in the Punjab.—Perry, Adie, Smith, C. M. Bureau.

For many years it was not supposed that *M. listoni* occurred so far to the west as the Punjab. It was not found at Mian Mir by the Royal Society's Commission nor is it mentioned by Adie in his list of species taken at Ferozepore.* In 1910 Perry among numbers of *M. culicifacies* caught at Kuthala near Gujrat found specimens which resembled *listoni* in their wing markings, and some of these seen by James were thought definitely to be *M. listoni*. One or two more specimens were taken at the foot of the hills near Kalka. *M. listoni* has also been received on several occasions among anopheles sent by Major Smith, R.A.M.C., from Rawal Pindi.

* Adie (1905) refers to specimens in his collection (*M. fluviatilis-listoni*) taken in Kashmir.

At Amritsar during 1909 10 this species was not encountered, though many hundreds of anopheles were examined It was very surprising therefore in the spring (early part of April) of 1911 to find it in large numbers on the outskirts of Amritsar Altogether more than two hundred specimens were taken at various times during April in a particular neighbourhood and stray specimens were found in other parts of Amritsar That this appearance of a spec es hitherto thought to have been *absent was not the result of its having been* confused in the past with *M culicifacies* is shown by the examination of a large batch of anopheles caught at various times at Amritsar and preserved at the Bureau Also the specimens were at once recognised as something quite new by the collector

A comparison of specimens taken in Calcutta with those taken at Amritsar and at Rawal Pindi shows no differences in markings or structure In the Amritsar specimens the attitude was seen to be that of an ordinary anopheles and not that of *M culicifacies*

III —P jeyporiensis (James) —Perry C M Bureau

A large number of this species from the Jeypore Hills has been sent by Major Perry I M S, to the Bureau So far practically no specimens have been available for study since the species was first taken in the Jeypore Hills, and there was a good deal of uncertainty in respect to details of scale structure, etc The specimens now sent shew it to be a very distinct *Pyretophorus* and the scales on the thorax though narrower than those on the thorax of *N fuliginosus*, for example, are much more distinctly true scales than the thoracic scales of *M listoni* or *A turkhudi* Being snowy white they are also very conspicuous under the microscope The legs are very distinctly banded at the tarsal joints, but the bands though quite distinct are narrow The mosquito is darker than *M culicifacies* or *M listoni* and the narrow

very clear tarsal banding at once distinguishes it If *M culicifacies* shows banding it lacks the distinctness of that of *P jeyporiensis*

IV—P gigas in Assam hills (McCombie Young) *P simlensis* Murree (Gill) —A specimen of *P gigas* caught at Shillong (4,900 ft) in May was received from Captain McCombie Young, I M S It shows no bands on the palps and so resembles the typical *P gigas* of the Nilgiris A series of specimens of *P simlensis* from Murree and another series bred out from larvæ taken at Kasauli all showed well marked and *in some cases very conspicuous* bands on the palps

V—A turkhudi at altitude of 6,000 feet (Gill, Acton, Christophers)—

A turkhudi has generally been found breeding in shallow pools in connection with river beds (Jumna at Delhi, river Beas, nullahs near Nagpur, etc) In August 19 o one of us found this species breeding freely in pools in a small stream below *Kasauli at a height of about* 4,000 feet Since then (June 1911) specimens have been bred out at Murree (7 000 feet) and caught in bungalows at Kasauli (6,000 feet) *A turkhudi* is therefore to be looked upon as a species occurring at considerable altitudes in the Punjab hills The *thoracic scales in the specimens caught at Kasauli are similar* to those of *A turkhudi* caught at Beas There is no reason therefore to believe these mosquitoes to be *P nigrifasciatus* a species taken near Quetta at a considerable altitude (5,000 feet or more), unless *P nigrifasciatus,* as suggested by James, is only *A turkhudi* *

VI—Reduction of palpal bands in N maculatus N maculipalpis (Adie, Gill, Krishna Rao) —Adie notes that in *N maculatus* caught in the Kangra Valley the two terminal palpal bands in some cases coalesce to form a single broad

* Captain G I Davys I.M S *has recently sent a valuable collection of anopheles* taken at Quetta It includes many specimens of *P nursei* and a few *P nigrifasciatus* Both these species are quite distinct from *turkhudi* and clearly belong to the genus *Pyretophorus A new description of them will be given in the next number* of these transactions (S, P J)

terminal white band In such specimens the wing markings are lighter in colour and marked somewhat differently from the normal Gill and Krishna Rao find similar blending of the terminal bands in a certain proportion of the same species caught in the Ravi near Pathankot

Adie also records *N maculipalpis* as showing the same reduction of bands on the palps but without much change in the wing markings

VII —Larva of Ne fowleri (Kenrick) —The larva resembles that of *N fuliginosus*, but the median frontal hairs are more branched There is no branched hair on the antennae The median and external frontal hairs are branched, there is no posterior pair of hairs There are no palmate hairs on the thorax or on the first abdominal segment The second segment carries undeveloped palmate hairs Well developed palmate hairs are present on the 3rd to 7th segments The filament is half the length of the stem of the leaflet and ends abruptly at the base of the leaflet

The larvæ are found in ricefields, in borrow pits and in tanks, as well as in leakage and overflow water from these when near ricefields They are not found in flowing water and prefer water with weeds and grass The species is one of the commonest anophelines in the Central Provinces at certain times of the year (cold weather) and is pre eminently the ricefield species

VIII —Ne willmori a proved malaria carrier in nature Sporozoites have been found by Mrs J R Adie in the salivary glands of *Ne willmori* caught in the Kangra valley A communication is promised for the next number of this publication

REVISED AND NEW DESCRIPTIONS OF INDIAN ANOPHELES

(With plate)

The monograph of the anopheles of India by James and Liston forms a complete revision of the adult stages of the Indian species But in a number of the species the egg, larva and nymph still remain undescribed, and in others the descriptions of the immature stages require revision or more detailed treatment There are also a few species in which, owing to want of material, the description of the adult stage has still to be revised, *e g* *P nigrifasciatus, P nursei* etc This will be done in the present section as material becomes available Only descriptions will be utilised in which the actual adult insect, being preserved in the Bureau, is available for study at any time In the case of eggs both the adult laying them and the eggs themselves will be preserved and catalogued In the case of the larva and nymph, the skins mounted in balsam will be kept along with their respective mature insects It is intended by these precautions to avoid the error which is so apt to occur of an immature stage of one species being described as that of another

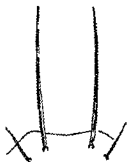
I—Egg of M listoni (C M Bureau)—Four gravid female *M listoni* (No 347 Mus Cat) caught at Amritsar were allowed to oviposit All laid eggs of the following description (No 348 Mus Cat) —

Type I—Floats do not touch rim of upper surface

Upper surface narrow, *separated into two areas* each of which *is surrounded by a narrow frill* (*Vide* Plate)

Lower surface shagreened, un ornamented

Floats long, occupying more than half the length of the egg, about 20 crinkles



1



2



3



4

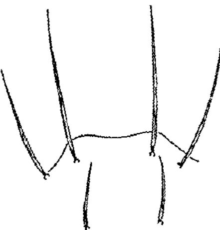


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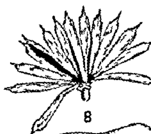


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Ch halli



7



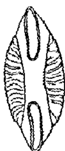
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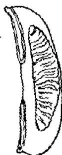
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10

Ne willmori



11



12

N ltstoni



13



14

N maculatus

from papillæ close to the base of the median hairs There are two small posterior hairs (*Vide* Plate)

The mental plate is bluntly conical in shape and bears nine rounded teeth The maxillæ carry a branched hair which arises from the outside near the apex and carries at its termination the following structures, two thick spines, a small foliate plate, a small flat process carrying two twin spines The mandibles carry four large curved spines, a mass of similar but smaller spines, and a comb lying below the mandibular teeth The mandibular teeth are blunt pointed and about five in number

The hairs arising from the thorax are similar to those of other anopheles larvæ but are small and imperfectly developed The abdominal lateral hairs are also rather delicate and short *There are the usual double oar shaped hairs on the first* two segments and a single oar shaped hair on the third segment The rest of the lateral hairs are simple

Palmate hairs are carried *on the 3—7 segments They* are of moderate size measuring in the adult larva 12mm In one larva in which they were counted the leaflets born by the different segments proceeding from the 3rd to the 7th was 11, 16, 16, 14, 12 The hair on the 7th segment is often rather small and inconspicuous

The greatest breadth of the leaflet is about one sixth the total length including the filament The leaflet ends in a series of rather pointed teeth usually about three on each side of the filament These lead up gradually to a short *pointed filament From the most basally placed "jag"* to the point of the filament is about one sixth of the total length of the leaflet

The spiracle comb carries three large smooth processes and about eight smaller spines carrying fine teeth

The hairs arising from the ninth segment are rather short and poorly developed

A feature which serves to distinguish the larva of this species from that of all previously described ones is the extreme shortness of the external frontal hairs

The nymph resembles in general appearance that of other anopheles The air trumpets are of the shape usual in anopheles They measure 45 mm from origin to terminal margin The first abdominal segment carries a pair of large fan shaped hairs The hairs on the succeeding segments are very small and feeble Lateral spines are present on the 4—7 segment, but are small and ill developed. That on the 7th segment is, however, of medium size The anal flaps measure 8mm They are fringed with minute hairs

The above descriptions are from cast skins of No 160 (I), (II), and (III), Mus Cat

The larvæ were found abundantly in Golaghat in January in small muddy pools resembling the breeding places of *Nm rossi* and in footprints of cattle At the time of the year they were caught this species next to *My nigerrimus* and *N fuliginosus* was the commonest anopheles

IV —Larva and nymph of Ne willmori (C M Bureau) — The larvæ have no distinguishing feature to the naked eye

The head markings are generally a dark V shaped mark with a spot in front of this There may be a bar in front of this again and two small spots near the eyes

The antennæ have the usual characters There is no branched lateral hair The spines covering the body of the antenna are rather well developed The basal hair is branched and about as long as the antenna

The frontal hairs are simple The median pair arise about half their length from one another and the external ones about half as far again external to this The external hairs are somewhat shorter than the median There are two rather well developed posterior hairs which reach forward as far as the base of the median hairs

The mental plate is blunty conical and carries 9—10 rounded teeth The mandibles and maxillæ do not differ appreciably from those of *C halli* described above

The thorax and abdomen carry the usual hairs

Rudimentary palmate hairs are present on the second segment, well developed ones on the 3—7 segments They are of moderate size, measuring in the adult larva 12mm In one larva in which the leaflets were counted they numbered on the different segments proceeding from the 3rd to the 7th segment 14, 13, 14, 15, 10

The leaflets at their broadest part measure slightly more than one sixth of their total length, including the filament They terminate in a series of steps about three on each side of the filament These lead up gradually to a short pointed filament From the most basally situated step to the point of the filament is about one fifth the total length of the leaflet

The spiracle comb carries four large processes one of which carries fine teeth and about nine smaller spines with fine teeth

The nymph resembles in general appearance that of other anopheles The air trumpets are of the shape usual in anopheles They measure 47mm They are fringed with short hairs The first abdominal segment carries a pair of large fan shaped hairs The succeeding three segments carry on the dorsum respectively, an outer simple and inner branched hair, two branched hairs and a simple hair, two branched hairs

The three penultimate segments carry each a pair of long inner simple hairs and a pair of outer branched hairs In addition to these hairs the 3rd to the 7th segments carry dark coloured stout spines which increase in size as one passes backwards On the last segment this spine is represented by a dark stout branched hair The anal flaps measure 8mm and are fringed with minute hairs

The larval and nymphal description is from the cast skin of No 375 Mus Cat

The larvæ and nymphs of *Ne willmori* are remarkable for their power of remaining at the bottom of the small rocky or stony pools in which they are found

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AN INVESTIGATION INTO THE PREVALENCE OF KALA AZAR IN A PART OF UPPER ASSAM

BY

S R CHRISTOPHERS

The name *kala azar* was first applied to a peculiarly fatal fever which had been present for some time in the Garo Hills, a tract of comparatively low hills lying to the south of the Brahmaputra at the lower end of the Assam Valley In 1882 when investigated by McNaught, Civil Surgeon of Tura, the disease seems to have been unknown in other parts of Assam But a little later what was evidently the same disease became prevalent in the Goalpara District lying to the north of the Garo Hills, and in the course of years successively attacked Kamrup, the adjoining district on the north bank of the river, and Gauhati, the district lying opposite to Kamrup on the south of the river In each case after lasting a certain number of years the epidemic conditions declined and the districts were in turn abandoned by the disease

In 1889 at the time of Ross's investigations into *kala azar,* this disease, though it had died out, in epidemic form at least, from Goalpara, was present in Nowgong and had spread to Mongaldai and Tezpur *Kala azar* had therefore extended in the course of some twelve years in successive steps about half way up the Assam Valley Since 1889, a period of twenty years, no known further extension of the disease in epidemic form has taken place

But quite recently Captain Morison, I M S, Civil Surgeon of Sibsagar, has drawn attention to the occurrence of what he believed to be *kala azar* in certain villages in Golaghat, a sub division of Sibsagar adjoining Nowgong It was on account of the importance of this announcement that the present investigation was carried out

The facts known at the time of my visit were as follows —

Captain Morison, I M S, had recorded a number of cases seen by him in the villages of Khumtai, Melamara and Habichoa, which, from their history and other clinical evidence, he believed to be *kala azar* he also showed that a considerable number of deaths from what appeared to be this disease had already occurred in these villages Captain McCombie Young I M S, who later visited the area, similarly records his opinion that the cases referred to were *kala azar* and was able to make an autopsy on a patient who died whilst he was in the neighbourhood *Vide* case 1

At first cases were reported only from the Khumtai *mausa* which lies to the west of the sub division But during the course of Captain Morison s and Captain Young's investigations some further cases were reported from a village in the Naharani *mausa* which is situated in the extreme eastern portion of the sub division These cases, seen by Captain Young, were also pronounced on clinical grounds to be undoubted *kala azar*

There were thus three villages—Khumtai Melamara, and Habichoa—in the Khumtai *mausa* and one village—Dumjoona—in the Naharani *mausa* suspected to be infected with *kala azar*

My own investigations were commenced at Khumtai A camp was arranged on the outskirts of this village and a careful house to house examination made Altogether within the boundaries of the village there were 105 houses which, as is usual in this part of Assam, were very scattered, the whole village stretched about two miles from north to south and about a mile from east to west

Fifty one houses, forming the north and south extremities of the village, were occupied by ex tea garden coolies immigrants from other parts of India Among these only three suspected cases were found In one of these (case 7) spleen puncture showed no *leishmania* parasites

The central portion of the village consisted of 54 houses occupied by native Assamese (*ahoms*) In 19 of these houses one or more cases, suspected to be *kala azar*, were found The spleen blood was examined in 11 cases In three cases in which the clinical diagnosis was doubtful the result was negative Three cases thought to be *kala azar* also yielded negative results The remaining 5 cases showed *leishmania* parasites It will be seen, therefore, that in this village among the native Assamese *kala azar* was very prevalent

At Melamara, a few miles from Khumtai, only two suspected cases were discovered as the result of house to house examination In neither of these cases did splenic puncture show *leishmania* parasites

At Habichoa, a mile or two further distant, house to house examination yielded 6 cases which were thought to be *kala azar* The splenic blood was examined in five cases, all of which showed parasites

At Dumjooria all the reported cases had been found in a portion of the village consisting of about a score of houses In this small group of houses no less than six infected families were found Four cases were examined by splenic puncture, all of which showed parasites

Thus, in each of the reported centres, except perhaps Melamara, there could be no doubt as to the existence of *kala azar*

Distribution of kala azar *in Golaghat*

Though cases had been reported from only four villages, it was not at all certain that infection was limited to these In order to ascertain the prevalence of *kala azar* in the district generally, a house to house examination was made in as many villages as possible, the spleens of the inmates being palpated with a view to detecting cases of the disease

In the villages Basagaon Sapenokoboa, and Lukkurakhnea near the Nowgong border 259 village people were examined The only suspected case of *kala azar* was a boy in a Kayah's shop who had a very large spleen and a history of fever Moderate enlargement of the spleen (malaria) was present in 77 per cent of the children of these villages taken collectively In the same neighbourhood Captain Morison made a spleen census among over 300 coolies on tea gardens There were a number of very large spleens reaching to the umbilicus, but the general spleen rate was very high (84 per cent), and Captain Morison was of opinion that none of these were cases of *kala azar*

Further east at Dangaon 102 village people were examined In two cases the spleen reached to the umbilicus At Mokaligaon 67 people were examined and no very large spleens encountered At Kolakua, a village of ex tea garden coolies, one girl with a very large spleen was seen and this may have been a case of *kala azar* In all these villages the general spleen rate was high

At Saporialgaon, a small village in the same neighbourhood, only 36 people were encountered in a house to house examination, but of these four had spleens reaching to the umbilicus and five possessed spleens almost as large The general spleen rate (18 children only) was 66 per cent Under the circumstances of our visit it was not possible to perform splenic puncture, but there seemed reason to suspect that this village was a focus of *kala azar* On a garden in this neighbourhood Captain Morison found among 87 children 5 with spleens which reached to the umbilicus Again it was doubtful if any of these were *kala azar* (*Vide* remarks given later on certain types of very large spleen)

Still further east beyond the river Dunsiri the infected Khumtai Habichoa area is approached At Bungaon, eight miles from Khumtai, 130 people were examined The spleen

rate was low, being only 23 per cent Six adults, all long settled ex garden coolies, showed enlarged spleens reaching to the umbilicus In all of these there was a very long history and in only two was there any sign of general ill health The most suspicious of these cases was examined by splenic puncture, but no parasites were found

In the neighbourhood of Golaghat town lying to the south of the Khumtai area 167 people were examined In two cases the spleen reached to the umbilicus though the general spleen rate was low (20 per cent) A case (case IV) coming from a village four miles outside Golaghat was thought to be *kala azar*, but splenic puncture yielded only malaria parasites (quartan) and another case (case II) with a large spleen coming from another part of the district also showed quartan parasites.

Proceeding again eastwards towards the heavily populated sub division of Jorhat, a number of villages were examined At Gujagania 323 people were examined In three cases the spleen reached to the umbilicus In one of these the spleen was punctured, but no parasites were found The general spleen rate was low, being 19 per cent At Dumjooria infection was found to be practically confined to the group of houses we had previously examined Excluding the focus 124 people were examined No cases in which the spleen reached to the umbilicus were seen, but one case with a somewhat smaller spleen was suspected to be *kala azar* At Baltipuria (Mussalmangaon), where, as we shall see, *kala azar* is stated to have been at one time epidemic, 96 people were examined, but no very large spleens were found At Dergaon 181 people were examined, but no suspicious cases were found At Dodara Ahom 115 people were examined and one child was found with a spleen reaching to the umbilicus (doubtful if *kala azar*) In all these villages the spleen rate was remarkably low, the percentage taken collectively being 15, whilst at Dumjooria it was only 4

These results show that *kala azar* is not generally prevalent, but occurs chiefly in the form of foci They show also that the distribution of *kala azar* is in no way related to that of malaria *

Considerable difficulty was felt in arriving at a diagnosis in what may have been sporadic cases of *kala azar* Cases of very large spleen in ex garden coolies were also a source of difficulty On the whole, experience gained by splenic puncture showed that the following types of very large spleen might be distinguished —

(1) Large spleens yielding *leishmania* on puncture

(2) Large spleens in which no parasites are found even when many splenic cells are included in the blood drawn from the spleen Nevertheless not infrequently in these cases the history and clinical evidence very strongly suggest *kala azar* (*Vide* cases XII, XIII, XIV and XXIII) It is possible that at certain stages of the disease parasites are greatly reduced in numbers or that they are absent from portions of the spleen

(3) Very large spleens exactly resembling *leishmania* spleens, but there is usually a very long history and the patient, though he may be anæmic, is well nourished and may even be robust The frequency of this condition among the immigrant coolie population from certain localities, *e g* Arrah, is very notable A very similar condition is common in the Punjab and is drawn attention to by Ferguson and Day in Egypt (*Vide* cases II, V, VI, XXIV)

(4) Very large spleens associated with marked anæmia and often with a considerable amount of œdema of the face and ascites To superficial examination these cases often *simulate kala azar very closely, but on puncture they yield only* malaria parasites (*Vide* cases II, IV)

* See also Scientific Memoirs New Series No 19 *Kala azar, Malaria and Malarial Cachexia* by S P James

History of kala azar in the focus at Khumtai

The first deaths from *kala azar* in Khumtai are stated to have occurred in or about 1900 At this time there existed a portion of the village, now quite deserted, to the north of the present centre The village as it now stands consists in fact partly of houses which once formed part of the original village and partly of houses of more recent construction built by families who at various times had moved out of the now deserted portion Until quite recently (1909) there was no history of *kala azar* among any of the families living in the old standing houses But no less than eleven out of fifteen families in the newer houses show cases or have a history of *kala azar* Some families moved away from the old village site fifteen or sixteen years ago, these have no history of *kala azar* Others who moved away in 1904, in 1907, and at the final exodus in 1908 have shown infection The origin of most of the infection in the village can therefore be traced definitely to the old deserted village site, and it seems probable that the disease originated as stated some time prior to 1904

Old maps and records have enabled this portion of the village to be reconstructed It consisted of 23 houses rather closely aggregated The first cases are stated to have occurred in 1900 in a family living in a house (No 587) situated in the centre of the group By 1908 the disease had shown itself in eight more families living in the area Four families who had been free from the disease in the area have also since developed *kala azar* in their new homes This small group of houses formed then a veritable focus resembling that described at Dumjoorra

The first cases of *kala azar* in Khumtai not traceable to this focus in the old village occurred in house 957 where three deaths took place during the years 1909 1910. Up to

date one other death has occurred *in the house next to this* and five out of seven houses forming a small group around it show certain suspected cases of the disease This then forms another focus quite recently started

As regards the origin of the first cases in Khumtai, the villagers state that on at least two occasions *viz* twelve and five years ago respectively, people fleeing from Nowgong settled in the village and to these the presence of the disease is ascribed

At Habichoa the first case among the villagers is stated to have been in a youth called Nagiram About two and a half years ago Nagiram died after about six months illness with large spleen and constant fever Debi another member took ill of the same disease and died about six months ago after four months illness Bhadai wife of Debi then got sick and died in December 1909 after suffering for about five months A girl aged 8 was also stated to have been sick with the same disease and to have been on the point of death, but to have recovered She now shows no sign of *kala azar* Another inmate, Katin aged 16 took ill with the same disease in April 1910 He now has a spleen reaching to the umbilicus is emaciated, feeble and anæmic (case XVII) The wife of another brother died in November 1910 and the husband is case XVIII

Infection has therefore actively progressed in this family, which yielded two of our cases The other cases seen gave no past history of cases of *kala azar* in the family

As at Khumtai the disease is said to have been brought by people from Nowgong Whether this is so or not it is impossible to say In any case the appearance of the disease in Habichoa seems to be of a more recent date than was the case in Khumtai

At Dumjooria it is stated that some eight years ago a severe epidemic of *kala azar* broke out in a neighbouring village called Mussalmangaon (portion of the village Baltipuria), as a result of which nearly half the people there died and many others left the village The Mussalmans who first suffered are said to have traded in cattle with Nowgong and it is suspected that they made a business of buying up cheaply the cattle of those who had died from *kala azar* The first to contract the disease in Dumjooria was a man called Tuai, who is believed by the villagers to have become infected from sleeping in the same hut at the silkworm rearing time with one of the Mussalmans from Mussalmangaon Tuai was related to the household in which the disease next occurred (house 312) Since then *almost all the houses in this cluster of huts have become infected* forming the focus already mentioned

It is interesting to find that at Mussalmangaon where so severe an epidemic is said to have occurred no indication of the disease is now to be found

Summary and Conclusions

Kala azar is present in Golaghat *at the edge of or a little beyond the limits of the area affected by the great kala azar* epidemic of Nowgong The disease is not diffused generally over the district, but is in the form of small foci

A remarkable feature of these foci is the large proportion of infected persons

At Mussalmangaon a severe epidemic of the disease seems to have disappeared and left no trace At Melamara and Habichoa the disease does not seem to be very active At Khumtai and in the Dumjooria focus the transmission of infection is, or has been until quite recently, in active progress

Without a much more extended enquiry it is not possible to gauge with certainty the significance of these small foci or

to say whether they represent the commencement of the spread of epidemic conditions, the slowly dying embers of past epidemic conditions, or a state of endemic prevalence of *kala asar* which may be of wide occurrence in certain tracts of India

I desire to acknowledge the kind help I received whilst carrying on the investigation from Captain Morison, I M S, Civil Surgeon of Sibsagar, who personally assisted in the house to house examinations, the results of which are recorded in this paper It is also due to Captain Morison to state that many of the spleen punctures were made by him

Cases

Case I —Adult woman, Habichoa autopsy made by Captain Young I M S, smears sent to Kasauli showed no parasites, but sections of a piece of spleen tissue kindly given to me by Captain Young showed scanty parasites collected here and there in the large cells characteristic of infection by *Leishmania*

Case II —Adult man, ex garden coolie from near Kamar band Ali, 4 miles east of Golaghat Spleen approaching umbilicus, marked anæmia, and œdema of right leg below the knee

Spleen punctured 5th January 1911 Fairly numerous quartan parasites No *Leishmania*

Case III —Boy aged 9 Bengali Came with his family to Golaghat town from Nadia in Lower Bengal about 5 years ago Was then healthy Began to suffer from fever and spleen about a year ago Spleen to umbilicus large and massive, liver enlarged, emaciation marked, anæmia considerable

Spleen punctured 6th January 1911 *Leishmania* present

Case IV —Boy aged 8 Native Assamese from Naragaon, about two miles from Golaghat History of persistent fever, spleen nearly to umbilicus, fluid in abdomen and œdema of eyelids and face, marked anæmia, no noticeable wasting

Spleen punctured 11th January 1911 Large rings (quartan) No *Leishmania*

Case V —Adult man Native Assamese Seen in jail, but came a few days ago from Kakolekigaon near Habichoa *Spleen nearly to umbilicus, large and massive Long history*

Spleen punctured 12th January 1911 *No Leishmania* or malarial parasites

Case VI —Adult man aged 20 Living in house 32, Khumtai Case reported as *kala azar* Came three years ago from Arrah district (near Patna) After living some *months in Khumtai had quartan fever, which lasted for about* six months Recovered from this, but lately has been suffering from fever of a continuous type and is said to be darkening *in colour Spleen a hand's breadth Some anæmia*

Spleen punctured 13th January 1911 *No Leishmania* or malaria parasites

Case VII —Adult *man* Ahom (Native Assamese), Khumtai Living in house 3 Spleen a hand's breadth Man otherwise healthy

Spleen punctured 12th January 1911 No *Leishmania* or malaria parasites

Case VIII —Boy (Garia) aged 9 *years Ahom* Khumtai Living in house 1 Spleen a hand's breadth Slight anæmia Emaciation doubtful

Spleen punctured 13th January 1911 Very numerous *Leishmania*

Case IX —Boy (Terok) aged 7 Ahom Khumtai Living in house 16 Spleen nearly to umbilicus, very tumid Anæmia marked Slight emaciation Brother aged 6 has spleen to unbilicus, anæmia and œdema with ascites

Spleen punctured 13th January 1911 Very numerous *Leishmania*

Case X —Youth (Petua) Ahom Khumtai Living in house 27 Spleen to umbilicus History of continuous fever No distinct emaciation or anæmia Reported as a case of *kala a ar*

Spleen punctured 13th Janua y 1911 Numerous *Leishmania*

Case XI —Adult (Robi) Ahom Khumtai Living in house 53 Three months' history of illness Has lived for four years in Khumtai in the same house but previously lived at Habichoa Spleen to umbilicus, massive Anæmia Rather thin

Spleen punctured 15th January 1911 Numerous *Leishmania*

Case XII —Boy (Marun) aged 5 years Ahom Khumtai Living in house 26 Since birth spleen nearly to umbilicus Four of the family have died in the last two years from *kala azar* Father and mother both have hand's breadth spleens One brother has spleen nearly reaching the umbilicus (case XIII) and another a spleen four fingers' breadth

Spleen punctured 15th January 1911 No *Leishmania*

Case XIII —Boy (Nalia) aged 7 Brother of case XII Spleen nearly to umbilicus

Spleen punctured 16th January 1911 No *Leishmania*

Case XIV—Youth aged 18 (Mulua) Ahom Living in house 37 Spleen a hand's breadth Otherwise appears healthy, but reported as a case of *kala azar*

Spleen punctured 16th January 1911 No *Leishmania*

Case XV—Adult man (Runghai) Native Assamese Melamara Spleen hand's breadth Doubtful case

Spleen punctured 17th January 1911 No *Leishmania*

Case XVI—Boy (Boghui) aged 12 Native Assamese Melamara Spleen hand's breadth Doubtful case

Spleen punctured 17th January 1911 No *Leishmania*

Case XVII—Youth (Kotia) aged 16 Native Assamese Habichoa Spleen to umbilicus and massive Liver considerably below costal margin Emaciation

Spleen punctured 18th January 1911 *Leishmania* present

Case XVIII—Adult man (Tonka) Native Assamese Habichoa Brother of case XVII Spleen to umbilicus, *liver well below costal margin Advanced case*

Spleen punctured 18th January 1911 *Leishmania* present

Case XIX—Adult man (Bhakola) Native Assamese Habichoa Spleen to umbilicus

Spleen punctured 18th January 1911 *Leishmania* present

Case XX—Adult man (Sobai) Native Assamese Habichoa Spleen to umbilicus Emaciated Eight months' history of illness

Spleen punctured 18th January 1911 Very numerous *Leishmania*

Has since died (February 5th)

Case XXI —*Adult woman (Pahi) Native Assamese* Habichoa Spleen to umbilicus Liver below costal margin

Spleen punctured 18th January 1911 *Leishmania* present

Case XXII —Adult (Manik) Native Assamese Khumtai Living in house 23 Spleen a hand s breadth, but bulky Man otherwise healthy

Spleen punctured 19th January 1911 No *Leishmania*

Case XXIII —Boy (Taheram) aged 10 Ahom Khumtai Living in house 28

Spleen punctured 19th January 1911 No *Leishmania*

Case XXIV —Adult Only likely case seen in the examination of some 350 people at the village of Gujaganiagaon Spleen to umbilicus Long history and man was otherwise healthy

Spleen punctured 23rd January 1911 No *Leishmania*

Case XXV —Boy aged 14 Native Assamese Dumjooria Living in house 265 Spleen to umbilicus Emaciation extreme

Spleen punctured 23rd January 1911 *Leishmania* present

Case XXVI —Boy aged 13 Native Assamese Dumjooria Living in house 276 A Spleen a hand's breadth Emaciation extreme

Spleen punctured 23rd January 1911 *Leishmania* present

Case XXVII —Adult Native Assamese Dumjooria Living in house 333 Spleen to umbilicus Emaciation marked

Spleen punctured 23rd January 1911 *Leishmania* present

Case XXVIII —Boy aged 10 Native Assamese Dumjooria Spleen to umbilicus Emaciation distinct

Spleen punctured 23rd January 1911 *Leishmania* present

Case XXIX —Boy aged 12 Ex garden coolie Spleen when first seen (January 11th) to umbilicus When seen about a month later spleen a hand's breadth Some emaciation Five years history of enlarged spleen States does not now get fever

Spleen punctured 5th February 1911 No *Leishmania*

MALARIOMETRY

Observations upon Graphs of the Spleen Rate and the Average Spleen

BY

S R CHRISTOPHERS

(*With plate*)

The spleen rate, being the percentage of children in any community showing enlargement of the spleen takes no direct cognisance of the size of this organ But the size of the enlarged spleen is important and cannot be neglected as an indication of the amount or intensity of malaria For this reason the Central Committee have recommended that the spleen rate be given in an extended form by placing the results of palpation in five classes according as the spleen is (1) not palpable, (2) palpable or one finger s breadth below the costal margin, (3) two to three fingers breadth below the costal margin (4) four fingers breadth or a hand s breadth below (5) still larger i e reaching to the umbilicus or filling the abdomen Major Ross employs for the same purpose four classes only and these are based upon an estimate of the *volume* of the spleen The first includes children in whom the spleen is not palpable In the second class the volume of the spleen is calculated to be about three times in the third class six times and in the fourth class nine times the volume of the normal spleen In practice the size of the spleen is estimated as a slightly enlarged, moderately enlarged or greatly enlarged spleen For reasons that will be clearer later, I believe Major Ross's fourth class to be identical with the Committee's fourth and fifth classes combined, and that the other three classes are the same in both cases

It is evident that both methods leave a great deal to the observer's personal equation, but for the present at any rate, there are practical difficulties which prevent the employment of any more precise method There is also reason to believe

that estimations by these rough and ready methods are not, within the limits of the standard employed, so inaccurate as one might think It has been my own experience that a spleen placed in one class by one observer will usually be placed in the same class by any other observer who may be on the spot

Weighted spleen rate

It is obvious that if one knew the relative value of the different classes as regards malaria, a weighted average based on such knowledge could be given Major Ross on the basis of volume has weighted his classes respectively 1, 3, 6, 9, and terms the weighted average so obtained "*the average spleen*" Similarly by omitting the class of normal spleens valued at 1, he obtains what he terms "*the average enlarged spleen*" Quite arbitrarily, for a purpose which will be clear later, I have made weighted averages, using the values 1, 2, 3, 4, 5 for the classes I to V respectively In future I shall designate these results, respectively, Average Spleen (Ross), Average Spleen (S R C), Average Enlarged Spleen (Ross) and Average Enlarged Spleen (S R C) As I shall show later, it does not matter how one weights the spleens provided the weighting is itself regular

Ross states that there is a relation between the spleen rate and the average spleen This is a fact which everyone who has examined a number of different communities must acknowledge But it is necessary to see to what extent this relation holds good and exactly what the relation is In a recent publication* I gave a series representing the proportion of the different classes of spleen in communities grouped in the order of their spleen rate In this series (about 3 000 in number) there is apparent a peculiar effect, resembling that

* Malaria in the Punjab Sc Memoirs by Officers of the Medical and Sanitary Department No 46

of a sliding scale, which first drew my attention to a very peculiar property of the spleen rate This series was the result of examinations made by myself, and the standard of measurement was, I believe, fairly consistent throughout, but for obvious reasons I have been anxious to make use of greater numbers and of data collected independently

In Major Ross's Report on Malaria in Mauritius are given, in tabular form, the results of spleen censuses by nearly a score of different medical men, amounting in all to about 30 000 children examined These Mauritius figures include four groups, a group consisting of about 19 000 examinations of children on Sugar Estates made by Drs Tennant, Menage, De la Roche, Lesur Chauvin Guerin Senneville, Ulcoq, Harel, Leclezio, Clarence, Bour, and Vinson a group consisting of about 6,000 examinations made on children in schools by Drs Keisler, Masson, Castel and a few (about 400) by Ross and Fowler, a group consisting of about 5 000 examinations made on children in various localities (about 4 000 by Dr Milne and about 1 000 by Ross and Fowler and a small group of about 800 examinations made by Ross and Fowler in which, however, the data for obtaining the average spleen are not given)

Of these the most important for our purpose is the first group consisting of examinations of children on Sugar Estates It is not only the numbers that make this series very valuable, but also the probability, since they deal with coolie labour and conditions where large numbers of children can be very readily obtained, that the detailed entries represent for the most part homogeneous communities—an important point as we shall see later

The examination of school children is less valuable, since we do not know to what extent admixture of different communities has taken place The fourth group is interesting in

that 3,900 of the examinations are by one observer, Dr Milne. The remaining 1,000 or so examinations contain only three examinations of over 100 children and do not require separate notice

We can then study the following series of examinations —

3,134 Punjab children by myself

18,909 Mauritius Estates children by various medical men

6,188 Mauritius school children

3,907 miscellaneous children by Dr Milne

I shall term these respectively Punjab series, Mauritius Estate series, Mauritius schools, and Mauritius Milne series

With these preliminary remarks, which seem necessary to a proper understanding of what follows, I shall proceed to the results of a study of graphs of the different values mentioned above For the sake of brevity, I shall employ symbols as follows — average spleen rate (Ross)=*A* (Ross), average spleen rate (S R C)=*A* (S R C), average enlarged spleen = *Ae* (Ross) and *Ae* (S R C) *respectively* I shall also indicate the spleen rate by the symbol *S*

Graphs of the Spleen Rate and Average Spleen

Plotting the points for *S* and *A* (S R C) in the Punjab series, they are found to fall very close to a straight line which passes through the field in a diagonal direction and which represents the simple linear function A= 02 S+1 Taking my own class IV and V as together equal to Ross's class IV and weighting the Punjab series with the values 1, 3, 6, 9 (Ross's method), the points fall close to another diagonal line representing the function A= 05 S+1

I shall now explain the diagram which accompanies this article* Along the left edge of the paper we have 100 divisions (ordinates) corresponding to the percentages of the spleen rate, the mark 100 being at the top left hand corner Along the base, and also marked on the upper margin, are divisions (abscissæ) 1, 2, 3, etc, representing the values of the *average spleen* or the *average enlarged spleen*, as the case may be, in terms of normal spleen The first line representing *A* (S R C) starts one division to the right of the left bottom corner (origin) and strikes the upper margin of the field at 3 (Q) The second line representing *A* (Ross) starts from the same point (which we shall in future call *P*) and strikes the upper margin of the field at about 6 (this point will in future be called Q)

Plotting the values *S* and *A* (Ross) for Mauritius estates the points fall with extraordinary regularity about a straight line passing in a diagonal direction and corresponding to the function A= 043 y+1 This line is evidently identical, or practically so, with the line previously given by the Punjab figures plotted by Ross's method of weighting It starts from the point P and passes a little to the left of Q (it actually cuts the upper margin of the field at about 5 25 (Q)

Weighting the Mauritius estate figures so as to obtain *A* (S R C), *i e*, multiplying the classes by 1, 2 3 etc, instead of 1, 3, 6, etc, and neglecting the small class V, the graph corresponds to that previously found for the Punjab series on my system of weighting

Both the Punjab and Mauritius figures therefore follow the same functions, *depending simply on the way in which the spleens are weighted* Weighted by my method they plot out along PQ, weighted by Ross's method they plot out along PQ Starting from the same point P it will also be observed

* Not —A further contribution dealing much more fully with the subject and accompanied by detailed and accurate charts will be published in our next number

that the two lines behave very similarly, except that for every space passed over by one (S R C) two spaces are passed over by the other (Ross)

In the Punjab series the number of points that can be plotted is limited by *the smallness of the numbers, but in the* Mauritius estate series there are nearly a hundred entries, of which 66 refer to numbers of children over 100 This series therefore enables one to follow very closely the distribution of the plottings As stated, the points for this series lie closely grouped along a line passing from *P* to about 5 25 on the upper margin It was noticed, however, that above and below 50 per cent the line was at a slightly different inclination and that *a slightly* curved line made a somewhat better fit, especially as it included the extreme upper values which were otherwise about 5 out This line will be referred to later as *pq"*

The Mauritius school series followed almost exactly the line PQ The line *pq* was evidently in this case not so good a fit Mauritius Milne series plotted out with remarkable *regularity along a line passing from* P *to a point beyond* Q (about 7 5 *pq"*), but this line was a very distinctly curved one *

Plotting the points for *S* and *Ae* (which latter it will be remembered is the "*average enlarged spleen*" obtained by omitting negative children and only averaging actually enlarged spleen), very distinct linear graphs were obtained, but of a quite different character to those just now described *Ae* (S R C) for the Punjab series gives a line commencing at 2 and ending above at 3 *Ae* (Ross) commences below at 4 and ends above at 6 These lines correspond respectively to functions of Ae= 01 S+2 and Ae= 02 S+4 *The Mau ritius* estates series follow almost identical lines depending

*It has since been ascertained that graphs *for A are always slightly curved* those for *Ae always linear*

upon whether the spleen values are estimated by (Ross) or (S R C) weighting

The Mauritius Milne series, which was peculiar in having a distinctly curved graph for *A*, showed for *Ae* a linear graph resembling those for the other *Ae* series, except that the upper end of the line passed more to the right, cutting the upper margin about 7

The graphs for *Ae* are much less diagonal than the others—in fact they surprise one at first by the way in which they pass almost directly up and down the field

Significance of the Graphs for A *and* Ae

That the graphs should be those of linear functions is peculiar and need not be further remarked upon for the present It is first necessary to know what they signify in regard to actual facts connected with the spleen rate

It will be observed that both the graphs for *A* start from the point *P* and not from the extreme corner (origin) This is because normal spleens being counted as I the graphs at o per cent spleen rate are at I, not o

Again, both my own and Ross s method of weighting results in graphs which are obviously related by a very simple function *The graphs simply follow then the notation we have employed* This must mean some extraordinarily regular relation between the spleen rate and the amount of enlargement of the organ, *and this appears to make it immaterial what values we give for weighting* so long as these are themselves in regular sequence. Whether Ross's method or the one adopted for the nonce by me, be used, the values arrived at can be converted from one to the other with a stroke of the pen For the time

we may consider the graphs of *A* as showing that the "*spleen rate*" and the "*average spleen*" are so closely related that they can be predicted one from the other To this subject we shall refer later

The graphs for *Ae* do not pass through P, but in each case they pass through either Q or Q' They pass through *Q* and *Q'* because at 100 per cent *A* and *Ae* are the same, there are no negative children to be considered

The small angle of the graphs for *Ae* signifies that the spleen composition, using this term to express the proportion of the different sized spleens at any particular percentage, does not vary very much The average size of enlarged spleens at 0 per cent spleen rate (supposing a theoretical case) would be 2 in the (S R C) notation and 4 in the (Ross) notation, it has only reached 3 and 6 respectively by the time 100 per cent is reached This stability of the spleen composition (even allowing as we shall see for the small number of groups that can be used to designate spleens of different sizes) is a very important character of the spleen rate It will be further dealt with in a later section, but before this is done it will be convenient to examine what I have defined above as the *Spleen Composition*

The Spleen Composition

If the proportion of different sized spleens at different percentages are studied, it will be found that in communities having a spleen rate below about 50 per cent the number of class II spleens is generally greater than that of class III, and that of class III than that of class IV But above about 60 per cent the proportional prevalence changes, so that class III spleen are now most numerous As 100 per cent is approached there is a still further shifting of the centre of gravity, so to speak, towards class IV, but this class never in my experience becomes sufficiently numerous actually to become the most prevalent

If a large number of observations are plotted it soon becomes apparent that there is a law determining in a homogeneous community the spleen composition for any given value of the spleen rate The proportions of the different classes in fact give what is evidently a rough picture of a frequency distribution for enlarged spleens of a quite regular nature

If percentages be marked off as ordinates and divisions 1, 2, 3 etc, as abscissae, these latter may be allowed to indicate our classes as follows The first division will indicate the limit of normal spleen, the mark 3 the position of the mean of Ross s class II (valued at 3) The mark 6 will be the mean of Ross's class III (valued at 6) and the mark at 9 the mean of his fourth class valued at 9 My fifth class, always comparatively small, will come one may suppose at 1^

If upon this scale, which gives an approximation to actual conditions, the spleen composition of a community having a spleen rate of say 80 per cent be plotted the resulting curve will be in form of a mound with its highest point at 6 and its concavity directed downwards At a spleen rate of about 60 per cent this curve may give place to an almost straight diagonal line and at lower values of the spleen rate the curve has its concavity directed upwards

Dealing with such a small number of classes as three or four, it is however evident that we get a very imperfect idea as to the nature of the real frequency curve Fortunately in the Punjab series the original observations were recorded in nine classes, and with this additional information it is possible to ascertain much more clearly what the actual curve is Plotting the spleen composition as recorded in these nine classes it is seen that the change in the shape of the curve previously referred to is more apparent than real The mode

does not change from its position (about $3\frac{3}{4}$ along the base line) and the only change which takes place in the curve is an increased skewness as the lower values of spleen rate are approached The change compared to what one might have expected is quite inconsiderable

Below 30 per cent it is difficult to follow the spleen composition as it becomes increasingly difficult to get sufficient data, and *the possible* effect of immigration from more malarious places and consequent interference with the natural spleen composition becomes increasingly great We know, however, from the graphs, supposing these to hold good so low down in the scale, that the average spleen at 0 per cent is (theoretically) 4, whereas it might, had all the spleens been within the limits of class II, have been 3 By a simple calculation therefore, which we need not give here, it can be shown that the average of 4 necessitates a proportion of *66 per cent class* II *and 33 per cent class* III, *supposing there to* be no spleens of still larger size The important point is that even at the very commencement of the appearance of enlarged spleens there should theoretically be a considerable proportion of the larger class spleens This is borne out by an examination of the observations giving low spleen rates among the Mauritius series Thus, between the spleen rates of 5 per cent and 15 per cent there are 3,494 children, and among these the spleen composition is 50 per cent, 36 per *cent and 16 per cent for the classes* II, III, and IV The spleen composition is therefore not noticeably different to what it is much higher up the scale

The most striking feature of the spleen composition is therefore its comparative fixity There is, however, a progressive change moderate in degree as we pass from low to higher spleen rates, which ensures, so far as one can judge with the data at hand, a fixed composition for each spleen rate Though imperfectly worked out, there would appear

to be at the root of the spleen composition a general law dependent on the fact that there is an almost fixed distribution curve for different sizes of spleen

One consideration perhaps requires mention as its omission may lead to error This is that in calculating the spleen *composition for a percentage one must not deal with a mixture* of communities under different conditions as regards malaria Thus, if 100 children from a community having a spleen rate of 90 per cent were mixed with 100 children from a community with a spleen rate of 0 per cent, it is obvious that we should get a resulting *spleen rate* of 45 per cent but a *spleen composition* for a community at 90 per cent spleen rate This may be a matter of practical importance, since a marked discrepancy between the calculated composition and the actual may lead one to suspect this mixture Thus one might surmise that certain estates which in the Mauritius figures show a spleen rate of only about 40 per cent., but a composition corresponding to 75 per cent, contained mixed labour or were subject to much immigration either from healthier or more malarious localities

Final conclusions regarding the nature of the spleen rate

We can now summarise what we have learnt regarding the nature of the spleen rate We know that theoretically it is not necessary to determine the average spleen or the average enlarged spleen because owing to some underlying principle connected with the nature of the spleen rate these values are fixed for any given spleen percentage Also we know that if we do wish to make a spleen average it does not matter what standard of weighting we use provided this is in itself regular The results are in terms of whatever standard we choose to employ

We have reason to suppose that as soon as any enlarged spleens are present at all there is a spleen composition very similar to the spleen composition at 100 per cent spleen rate

The composition differs in fact only in that there is a comparatively small incremental change We can measure this increment as well as the effect due to what we may call the fundamental spleen composition At 100 per cent spleen rate *Ae* (Ross) is roughly 6, and by a well known property of the average the spleens of a hundred members of the community would weigh, in terms of a normal spleen, 600 Similarly at O (*Ae* being as shown on the graph 4) the spleens of a hundred members of the community would weigh 400 This means that the fundamental spleen composition which is there from the beginning (as it were) is responsible for 400, whilst the remaining 200 which has developed as a result of passing from 0 per cent to 100 per cent is increment The increment we may liken to a wedge laid along the upper margin of a rectangle representing a population As the rectangle is encroached upon more and more by something which we may consider the presence of enlarged spleen, more and more of the wedge will be included Let us suppose that the encroachment has gone on to the extent of one half of the rectangle passing from right to left (this would represent 50 per cent enlarged spleens), then the thin end of the wedge would be included up to one half its length With 80 per cent spleen rate we should have covered four fifths of the rectangle and four fifths of the wedge This increment can be calculated by simple graphical methods from the graph of *Ae* the amount of the 200 total increment for any given percentage of spleen rate (proportionate to the amount of wedge included) being 02 S×S

Attempting to arrive by first principles at the essential nature of what has been discussed,' it seemed to me that the following conception as to the nature of the average spleen was of value The nature of the theory will be best demonstrated by working out a specific instance

Let us suppose the spleen rate to be 80 per cent The steps of the reasoning will be as follows —

There will be in a community of 100 people, 20 having normal spleens valued at 1 These twenty people will contribute to the total spleen composition in terms of a normal spleen	20
There will be 80 people who having enlarged spleens must at any rate have their fundamental spleen enlargement. These will contribute $\frac{80}{100} \times 400$ or	320
There is, however, the increment to go with this and being for 80 per cent this will be ·02 × 80 × 80 or	128
The total mass of spleen in the community of 100 people will therefore be	468
And the average spleen will be	4·68

This is close to but not *exactly* upon the line

Spleen rates of 70% 60%, 50% etc, work out as 4·08, 3·52, 3, 2·52, 2·08, etc, these being close to but not exactly on the line

From the above a formula can be deduced as follows —

$$100\ A = (100 - S) + \frac{(S \times 400)}{100} + (\cdot 02\ S \times S)$$

$$\text{or}\quad A = \frac{\cdot 02\ S^2 + 3\ S + 100}{100}$$

$$\text{or}\quad A = (\cdot 02\ S + 1)\ (\cdot 01\ S + 1)$$

If a curve be plotted from this function it will be found to fit the Mauritius estates graph very closely It was found to be in fact the line *pq*

As this hypothesis seems to reduce the facts regarding the spleen rate to very simple ones (the nature of the increment is still under study) the above formula may be considered for the time at any rate the function for the average spleen (Ross)

On the same reasoning the average enlarged spleen would be—

$$Ae = \frac{4S + 02 S^2}{S} = 02 S + 4$$

This, if plotted, gives a line lying along the previously described graph for *Ae*

Practical application of the facts ascertained regarding the nature of the Spleen Rate

That the spleen average can be calculated from the spleen rate is important in several ways It is important because except for some special purpose it will probably be found unnecessary to take the trouble to record the size of the spleen and it is of importance because it gives us the opportunity to ascertain the meaning and significance of variations which occur in nature For instance when Major Ross at considerable trouble calculates the average spleen for Mauritius as 2 54, we could (given the spleen rate) say that the probable rate for this (34 1 per cent) was on the straight graph 2 56 On the line *pq* it is 2 25, but this figure for a whole Island is not strictly an average spleen for this particular percentage, because it is obtained from a great admixture of communities But though these results make it reasonable to suppose that eventually we can in measuring malaria quite disregard the size of the spleen, they also make it very desirable to investigate for the time in more and more detail the different spleen values

To calculate the spleen average (Ross) from the spleen rate we may employ the formula for *pq* i e, (02 S+1) (01 S+1)

For use with actuals we may put this formula in the form—

$$A = \frac{2n}{N} + 1 \quad \frac{n}{N} + 1$$

Where n=the number of children with spleens and N the total number examined

An interesting point may in conclusion be brought forward, namely, what happens after the 100 per cent spleen rate limit has been reached? This does not often happen in nature, and in the whole of the Mauritius figures there is only one example of an examination yielding 100 per cent spleen rate (spleen composition not given) In my own series, I have one examination of 41 children from an extraordinarily malarious village who gave 100 per cent The values were A (Ross) =Ae (Ross)=6 5, A (S R C)=3 2 The calculated maxima are 6 and 3, but it must be remembered that our measure of percentages gives out at 100 per cent, whereas there is nothing to prevent a further increase of malarial intensity But by going back to the percentage from the average spleen we get the value 107 per cent We can thus continue our scale if necessary beyond the apparent limit of 100 per cent

As the Mauritius series on which the above has been chiefly based are available elsewhere, it is necessary only to give part of the data utilised The most important are the following records of the nine classes of spleen rate from the Punjab series The unchanging position of the mode is well shown —

Spleen	Over 90					80—90						/0—80				60—70		0—60.		40—50				Under 40				
	Janasi	Delhi (un h althy wa ds)	Bh ra v llages.	Actuals	Pe centage	Palwal	Am tsar llage	Bhera T wn	Amr tsar 1910	Act als.	Percentage proportio	Dhatir	Gurali Nurpur	Actuals	Percentage propo tion	Mian M r	Percentage	Gugrat v llages	Percentage proportion	Dharema	Bhalwal	Actuals	Percentage proport on	Nathuwala	Gujrat town	Kot momon	Actuals	Percentage proportion
Fillin Abdomen	1	2		3	1	1	3	0	2	6	1									..								
Beyond Umb l cus	2	4	8	14	3	5		1	6	14	3	1	1	2	2			2	2	1	1	2	2					
Hands breadth	4	10	10	4	6	10	5	2	6	23	5	2	4	6	5	2	2	3	3		1	3	4					
4 fingers ..	7	10	27	34	8	13	8	13	10	44	10	8	9	17	14	5	4	6	7		3	3	4		1	1	2	
3 finge s	6	6	48	/6	18	33	21	**27**	21	102	23	11	11	2	18	24	19	16	18	3	**15**	**18**	2	4	3	3	10	4
2 fingers	**14**	**32**	**88**	**134**	**32**	**41**	**32**	**26**	**42**	**141**	**31**	**25**	**17**	**42**	**34**	**44**	**35**	**26**	**28**	3	**15**	**18**	23	10	9	4	23	**39**
1 finger	3	9	46	58	14	9	12	17	22	60	13	9	5	14	11	6	21	18	20	3	**15**	**18**	2	5	8	4	17	29
Palpable	4	11	20	35	8	20	20	9	10	59	13	11	8	19	15	23	19	20	2	4	14	**18**	2	1	10	5	16	27
Not palpable	0	4	36	42	4	18	15	18	25	76	[illegible]	25	14	39	[illegible]	64		81		1	87	104		33	5	50	138	
Total with Spleen	41	124	247	412		132	03	95	119	449		67	55	122		124		91	..	16	64	80		19	23	17	9	
Total exami ed	41	128	283	452		150	118	113	144	525		92	69	161		188		172		33	151	18d		52	78	67	197	
Percentage	100	97	9			87	87	84	83			79	74			66		53		49	41			36	30	25		

The figu es in heavy type show the m de of the f eque cy curve

RECENT LITERATURE

Mathis *et* Leger *Paludisme et Anophélines dans la vallée de la Rivière claire de Tuyen—Quang à Hagiang* Bull de la Soc de Path Exot T III No 9 page 632
Mathis et Leger *La faune anophélienne du Tonkin* Bull de La Soc Med Chir de l'Indochine 13 November 1910

Mathis et Leger *La faune anophelienne du Tonkin dans ses rapports avec l'endemie palustre* *Ibid* 8 January, 1911

From the western border of Baluchistan to the eastern limit of Burmah embraces nearly 40 degrees of longitude or about one ninth of the circumference of the globe It is to be expected therefore that over and above differences due to varied physical and meteorological conditions we should, in passing from the western to the eastern extremities of the Indian Empire, meet with differences in the anopheline fauna due to the geographical distribution of different species In the western portions of North India, *Nm rossi M culicifacies N fuliginosus, Ne stephensi* and *C pulcherrima* are the common species Less frequent species are *My nigerrimus, My barbirostris N maculipalpis A turkhudi* On or near the foot of the hills are found *Ne willmori N maculatus,* both very common, and rarely *M listoni* At a higher level *Pt lindesayi Pt simlensis* and *A bartanensis* are met with In the United Provinces the fauna is not perceptibly different In Bengal, however, some changes occur *Nm rossi* is still at certain seasons the most common anopheles but *N fuliginosus* is most in evidence throughout the year *M listoni* is a common and in some parts the commonest anopheline *M culicifacies* is rare if present at all *M nigerrimus* is a common mosquito, and at the foot of the hills, in addition to the species already mentioned as hill species, *N theobaldi* is found *C pulcherrima,* so far as is known, is not found so far east In Eastern Bengal and Assam

M nigerrimus is a very common species, and with *N fuliginosus* forms the bulk of specimens of anopheles sent to the Bureau from this province In Sylhet and Assam a common species *Ch halli*, not so far recorded from any other part of India, is met with In Burma preponderance of *M nigerrimus*, to judge by collections sent to the Bureau, is again very marked *M listoni* is still very common in some localities at any rate The most marked change that has come about in passing into Burmah is the appearance of a new species *Nm ludlowi* which resembles *Nm rossi* but has speckled legs True *Nm rossi*, however, still occurs as well as *Ne stephensi*

These very briefly are the chief features of the distribution of Anopheles as far as we know them in a broad belt across India from the Punjab to Burmah, and the foregoing remarks are our reason for considering in some detail the results of the excellent work of Mathis and Leger on the anophelines of Tonkin, a country which touches the eastern border of Burma and is about the same latitude as Calcutta

Altogether Mathis and Leger have examined 8,625 anopheles caught in various parts of Tonkin In the Delta comprising the regions near Hanoi and the coast 3,383 anopheles were examined The commonest species was *My sinensis pseudopictus* (Wied) (60 per cent), the next most common was *Nm rossi* (33 per cent) *N punctulatus* (Donitz) formed 5 per cent of the whole and the remaining species which comprised *P superpictus* (Grassi) *My barbirostis*, *M tessalata* (Theobald 1901), and *M albirostris*, (Theobald) were each under 1 per cent *N fuliginosus* formed only 06 per cent

In the Moyenne Region 461 anopheles were examined The species found and their relative prevalence was much as in the Delta, *My sinensis p eudopictus* forming 59 per cent, *Nm rossi* 26 per cent, *N punctulatus* (Donitz) 11 per cent, and *N fuliginosus* only 1 per cent

Q Q' Q'

P P P

Fig 1

PUNJAB RURAL

20 40

90

50 60

40 50

Palpable

One finger

Two fingers

Three fingers

Four fingers

Handsbreadth

Beyond umbilicus

Filling abd men

Fig 2

The district of *haute Tonkin* was examined in October In addition to species found in the Delta M and L found one new *Myzomyia* and five new species of *Nyssorhynchus*, namely, *N christophersi* (*listoni*) *Ne stephensi* *N philippinensis*, *N jamesi* *Ne willmori*, and a species resembling *N masteri*

Considering the *haute Tonkin* as a whole the 4,781 anopheles examined were as follows —*My pseudopictus* 41 per cent, *N fuliginosus* 29 per cent, *Nm rossi* 8 per cent, *N punctulatus* 6 per cent, *N masteri* 4 per cent, *My barbirostris* 2 per cent and the remaining species under 1 per cent

There are a number of points we may remark upon The species *My sinensis pseudopictus* (Wied) of the authors is evidently *M sinensis* (Wied)=*M nigerrimus* (James and Liston) of India and Burma Excluding *My minutus* and *My nigerrimus* (Giles) as doubtful species, there remain in the group of species of *Myzorhynchus* having banded palps and none of the tarsal segments white the following described species between which there is, as will be seen, very little distinction —

Wing fringe with one pale spot *My sinensis* Wiedmann

Wing fringe unspotted

Wing with two yellow costal spots *My vanus* (Theobald)

Wing without prominent spots *My pseudopictus* (Grassi)

Indian specimens of *My sinensis* (Wied) show great variation in the wings, and such differences as those given above unsupported by other adequate differences must be of little value It is interesting to note that there is no *Myzorhynchus* at all described from the New World As in Burmah this species in Tonkin is evidently a dominant one

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Wing without prominent spots *My pseudopictus* (Grassi)

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The next most striking feature of the anopheline fauna of Tonkin to the Indian worker is the abundance of the species *N punctulatus* (Donitz) which formed 51 1 per cent of all catches This species is given by Theobald as identical with his *A tesselatum* and later as a Cellia (*C punctulata* (*Donitz*) If this is the species described by Mathis and Leger, it is not recorded at all from India It is difficult to feel much certainty about a species described under so many synonyms and finally only mentioned as a *Cellia* without any detailed description In the possession of eye spots and in the tips of the last tarsal segment being white, the species resembles *Ch halli* (James), but wing markings and palps differ greatly

The presence of *M albirostris*, the species like *N masteri* and *N philipinensis*, which are species not recorded from India, is also important, though it should not be forgotten that *N phillipinensis* is extremely close to *N fuliginosus* the presence of four palpal bands, in view of the frequency of this variation in India, being of little specific importance

The existence of *Nm rossi* and *M barbirostris* might be expected, as these species are recorded from Malay, etc *Ne stephensi*, *Ne willmori*, and *N jamesi* are evidently common to India and Tonkin *Ne stephensi* has been recorded also from the Phillipines, but Tonkin is the furthest eastern locality from which the two latter species have been recorded

In regard to the relation of the anopheline fauna to malaria, the authors believe that whilst *N christophersi* (*listoni*) *N fuliginosus*, *Ne stephensi* and *M barbirostris* are species transmitting malaria in nature, they are of opinion that in Tonkin *Nm rossi*, *M albirostris* *My pseudopictus*, *N punctulatus* and *N maculatus* are not concerned in the spread of malaria A most important point is the doubt thrown on *My pseudopictus* (*sinensis*) as a carrier of malaria in nature

In their last note the authors give a synoptic table of the anopheles of Tonkin on the lines of James and Liston's table for Indian species Tonkin being so close to Burmah it is probable that workers in Burmah will find it necessary to include the extra species mentioned above in their list of possible anophelines, and an indication of the position of these species in the Indian table may therefore be found of use

Addition to James and Liston's table for Burmah—

A —Wings unspotted   No additions

B —Wings spotted

1 Palpi unbanded   No additions

2 Palpi with 4 white bands (including white apex)

M tessellata (Theobald)	Cellia punctulata (?) of Theobald, Vol IV, page 109, and Vol V, page 71
N punctulatus (Donitz)	Wings much spotted None of hind tarsal segments pure white Eye spots on thorax
N masteri (?)	Given as having 4 palpal bands The chief point noted by Theo bald for this species is that it is like *stephensi*, but has the terminal half of the proboscis (not palps) pale
N phillipinensis	Probably N fuliginosus with 4 bands on palps

3 Palpi with 3 white bands (including white apex)—

Tip of palps black   No additions

Tip of palps white

(*a*) One or more hind tarsal segments pure white No additions

(*b*) Tarsal joints banded but no segments pure white

M albirostris	Legs not speckled Terminal half of the proboscis pale
	Two terminal bands on palps broad
	(In Nm rossi the second band is a narrow one)
P superpictus	Near *P jeyporiensis* but wing fringe unspotted

(*c*) Tarsal joints unbanded No additions

Howlett —*The influence of temperature upon the biting of mosquitoes* Parasitology, December 1910

The author has experimented with a view to find out what influences induce mosquitoes to "bite" Smell in the case of *S scutellaris* and *C fatigans* evidently played little or no part since they were not attracted by sweat, blood, etc Motion, form, and colour cannot be very important, as mosquitoes bite persons at rest and in the dark Very striking results were obtained, however, when the effect of temperature was tried Female *S scutellaris* and *C fatigans* enclosed in a gauze bag were attracted by and attacked a test tube filled with warm water and held near the bag No effect was produced when the tube was filled with cold water, nor were males attracted by the warm tube When the test tube was held so that convection currents did not reach the mosquitoes they were much less actively stimulated The effect of radiant heat was therefore not so much concerned as warm air currents set up by the heated body The same result in greater or lesser degree was obtained with *Nm rossi, N fuliginosus, N scataphagoides, S gubernatoris* and *S sugens S thomsoni* did not react, but also could not be induced to feed on a bare arm The conclusions drawn by the author are (*a*) that

the bite of a mosquito is a reaction to the stimulus provided by a hot surface, (*b*) that the mosquito is attracted to the hot surface mainly by the warm air rising from it, (*c*) that the strength of the reaction may within certain limits be proportional to the excess of temperature of the warm surface over that of the surrounding air On this last conclusion Howlett raises the interesting question whether mosquitoes bite when the air temperature is above that of the body

Howlett —*On the collection and preservation of insects*—*Ibid*, page 485

Howlett recommends for insect store boxes the use of paraffin with 5 per cent napthalin melted and poured in a thin layer (¼) over cork carpet (Suberit) previously painted white with a quick drying enamel (Paripan) For collecting nets he uses Swiss Bolting silk For closing tubes or bottles containing formalin solution Howlett recommends a plug of plasticine pushed down until the liquid spurts up through a pinhole which is made for the purpose and afterwards obliterated by a wipe of the tumb

Newstead and Carter —*Description of a new genus and three new species of anopheline mosquitoes*—Ann of Trop Med and Parasitology Vol IV No 3 page 377

The species *Dactylomyia ceylonica* is as its name signifies, from Ceylon The character on which the genus is founded is the presence of a pair of distinct and very pronounced tubercles projecting obliquely from the prothoracic region The figure given suggests that these are the prothoracic lobes (Patagia), which in that case would appear to be very prominent in this species The author places it near *anopheles* but up to the present that genus has not contained any brilliantly spotted species and the half white scaled proboscis, the broadly banded palps, the speckled legs and the many spotted wing veins bring it very close to *Neomyzomyia punctulata* (James and Liston)

The other species are *Py cardamatisi* and *C cincta*,—the former from Athens, the latter from West Africa

Ross and Thomson —*Some enumerative studies on Malarial Fever* Annals of Trop Med and Parasitology Volume IV, No 3, page 267

Thomson *A research into the production, life and death of crescents in malignant tertian malaria in treated and untreated cases by an enumerative method* *Ibid*, Vol V, No 1, page 57

These two papers represent a series of studies upon cases in which the enumerative method of Ross has been employed, the first being more or less preliminary in nature The results show the great importance of this method of research, but it is surprising to see that the well known cycle of asexual parasites followed some days later by crescents is apparently put forward in the first paper as a new discovery And in this connexion it seems fair to draw attention to the work in India of Buchanan,* who, in 1902, published an account of the relation of the sexual forms (crescents) to the asexual cycle in malignant tertian fever That crescents are not present during the early stage of an attack, but appear many days later—often not until the fever has abated—was, of course, known before Buchanan's paper was written, but the interest of his work was that he investigated the subject very closely by means of counts In all he described 14 cases in which daily counts were made of different forms of the parasite during periods up to a month, and,

* See transactions of the Malaria Conference held at Nagpur in January 190 page 33

(just as is described in the more recent papers) the counts showed that the summit of the crescent curve occurs with considerable regularity about ten days after that of the asexual forms associated with the fever The work had a further interest, in that, in addition to counts of total crescents, the number of crescents which on any particular day became "spheres" was recorded It is well known that not all crescents seen in the peripheral blood are equally prone to 'flagellate" and that while some retain their original form, others, including those which eventually "flagellate," become spherical Major Buchanan showed by his counts that the extent to which crescents become spheres and in the case of male crescents, the number that "flagellate' depends upon the period at which the blood is drawn When crescents first appear in the peripheral blood they are apparently immature for only a few become spheres or flagellate later on a larger and larger number exhibit these changes And just as crescents reach a maximum about ten days after the greatest prevalence of asexual forms, so the spheres are most numerous two or three days later still This relation was made very clear in the charts which Major Buchanan published and the charts also show that this observer although seldom quoted, has some claim to having employed a useful enumerative method a good many years ago

The most important points brought out in the first paper by Ross and Thomson are the decided correlation between the number of asexual parasites and the degree of fever, the non disappearance of asexual parasites in the interval between relapses, and the fact that a certain number (some hundreds per c mm) of parasites are necessary before fever is produced The authors lay stress upon the second point and are not in favour of Schaudinn s theory of the causation of relapses by parthenogenesis such a theory being considered by them unnecessary and unsupported by their own results Some important observations in relation to crescents given in this

paper are (*a*) that by no means every asexual rise is followed by a sexual one, (*b*) that the number of crescents never exceeded 5 per cent of asexual forms found in the generation (hypothetically) producing them The *first statement opens* up a particularly important subject in regard to the epidemiology of malaria, and in the list of investigations proposed in PALUDISM *will be seen one suggesting* research upon the influences, which, under different conditions of infection, etc, determine the output of gametes

The researches upon crescents are more fully developed in the second paper by Thomson, which is one of the most important contributions to the study of malaria made within recent years In all 42 cases of malignant tertian were studied in regard to the output of crescents 74 per cent of the cases showed crescents at some time or other, 26 per cent did not shew crescents at any time whilst they were under observation The number produced varied very greatly, some paroxysms being followed by as many as 7,000 per cm, whilst in others the number was much smaller A very important relation between the number of crescents produced and the severity of the attack is noted by Thomson In eleven acute cases in which the number of asexual parasites was over 50,000 per cm the *percentage which produced crescents was 37 5, and taking* the total numbers there was one crescent to 535 asexual parasites In eleven sub acute cases the percentage which produced crescents was 69 and there was one crescent to 81 *asexual parasites* In twenty six mild chronic cases the percentage producing crescents was 69 and *there was one crescent to* 52 asexual forms The mild and chronic cases had therefore a *crescent* producing power more than ten times greater than the very acute cases *

* See also the remark on page 488 of an article by Captain Smallman R A M C, in the Journal of the Royal Army Medical Corps May 1911

Investigating when crescents are produced, the author finds that after a single paroxysm of fever there is a simple crescent curve reaching a maximum ten days after the maximum of asexual forms When the paroxysms of fever are more continuous, the crescent curve becomes drawn out into plateau form In one case in which the patient had nine successive daily paroxysms of fever there were nine daily outbursts of crescents each occurring on the tenth day after the corresponding fever paroxysms The author concludes therefore that each brood of crescents arises from a brood of asexual forms and that they take ten days for development Since very few immature crescents were seen in these cases, Thomson thinks that the crescents undergo development in the internal organs, and that when fully grown they appear suddenly in the blood The prolonged continuance of crescents is not due to their long life but to the production of new forms by surviving asexual parasites Quinine was found not to begin to act on crescents until it had been given for ten days—a very strong reason for believing that it does not act directly, but indirectly upon the asexual parasites which produce them

Thomson believes that crescents are produced as an effect of the appearance of immunity in the host, and gives seven reasons for this, *viz*, (1) the observations referred to above in which mild and chronic cases gave rise in a greater proportion of cases to crescents and to relatively greater number of these, (2) that paroxysms occurring early in the disease tend to produce less crescents than those which occur later, (3) patients who have had previous attacks develop more crescents than those suffering from first attacks, (4) that fewer crescents were produced in the case of young patients, (5) that a low percentage of hæmoglobin is associated with a smaller output of crescents than a high percentage, the latter probably indicating according to Thomson a greater power to develop immunity, (6) that crescent production was greater in cases with enlargement of the spleen than in cases in which

there was no enlargement, (7) that the number of crescents varied directly with the number of leucocytes

Having regard to this relation between crescents and immunity the author draws attention to the possible evil effect of small doses of quinine and refers to one of the cases in which quinine in small doses appeared to stimulate the formation of crescents

Neiva —*Formacao de racas do hæmatozoaria do impaludismo resistante a quinina* Mem do Inst osw Cruz, Vol II, fasc 1, April 1910 Reference in Bull de l'Inst, Pasteur, Vol VIII, No 20, 30th October 1910, page 894

Nocht and Werner —*Beobachtungen über relative Chinin resistenz aus Brazilien* Deut Med Woch, 25th August 1910, page 1557

In connection with a large engineering undertaking in which some 3,000 workmen were employed, a campaign was carried on against malaria by Chagas and Neiva As the country was very swampy and intensely malarious, the only means of controlling the disease considered feasible was the prophylactic use of quinine As a result of the measures, it was found that the workmen themselves who were compelled to take quinine suffered but slightly, whereas the families of the workmen who refused to be treated were decimated by malaria The chief interest, however, of Neiva's results lies in the fact that they led him to believe that under certain circumstances strains of parasites could be developed, as a result of treating a community with quinine, which were resistant to quinine The facts on which Neiva bases his conclusions are as follows From February to September quinine prophylaxis on the whole was satisfactory and demonstrated a marked difference between the workmen themselves and their families But in spite of this a certain number of men who were taking quinine (5 gramme every third day)

developed attacks of fever In October therefore the same dose was given every other day This for a time was effective and stopped all attacks among men at work But in November malaria began to attack even men taking this amount and it was necessary to give the same dose daily in order to prevent attacks

Without entering into the question as to the possibility of quinine resistant strains of parasite being formed in the way suggested by Neiva and Werner, one cannot help considering their interpretation of Neiva's experiences somewhat open to criticism

It has been the experience of those in India who have had to deal with Europeans living in malarious districts that though a man after a time developes an immunity (tolerance) to malaria of a certain severity he succumbs if the intensity of the infection he is exposed to for any reason is increased, also that in order to meet a greater degree of malarial infection quite apart from any specific quinine resisting property of the parasite, it is necessary to increase the prophylactic dose of quinine Similarly, it is necessary to increase the dose where an increased amount of exposure or fatigue is to be counteracted

In the camp to which Neiva refers there was a rather curious state of affairs, namely, work men treated prophylactically with quinine and their families suffering severely from malaria There was no reason in fact why the amount of infection prevailing should not have gone on increasing steadily as the work progressed, and it would be quite in accordance with experience (the workmen being subjected to more and more intense infection) for the amount of quinine at first effective to be insufficient later

Again it is to be noted that the prophylactic doses used at first were extremely small Even the highest dosage

employed ($7\frac{1}{2}$ grains a day) is only very little above what experience in India has shown to be the least that in a malarious tract could be expected to be effective Europeans living in certain very malarious districts in India who practice personal prophylaxis take 5 grains daily for years without the least evil effect, so that $7\frac{1}{2}$ grains a day is by no means a large dosage

The difficulty in preventing relapses referred to by Werner has again to be carefully distinguished from difficulty in curing attacks, long standing cases of malaria may be resistant to treatment owing to some relation between the parasite and the tissues

The possibility of the existence of strains of parasite resistant to quinine is a most important one that requires the most careful investigation and Neiva's observations, if not conclusive, are very suggestive

The treatment of Malaria with 606

Nocht and Werner—*Beobachtungen uber relative Chinin resistenz bei Malaria aus Brasilien* Deut Med Woch, 25th August 1910, No 34, page 1557

Werner—*Das Ehrlich Hata Mittel 606 bei Malaria* Deut Med Woch, 1910, 29th September, No 39, page 1792

Nicolle and Conseil—*Action du 606 sur le Paludisme* Bull de la Soc Path Exot Vol III, No 10, page 708

Iversen Discussion at Konigsberg Deut Med Woch, 1910, 13th October

Werner—*Über die Behandlung der Malaria mit Ehrlich Hata 606 und uber Chininresistenz bei Malaria* Arch f Schiffs u Trop Hyg XV, No 5, 1911, page 141

The use of arsenical compounds in malaria has been frequently tried In 1902 a number of communications were made on the use of Arrhenal, and later in 1907 and 1908, when Atoxyl was being extensively used in the treatment of trypanosomiasis Koch and others found that this drug had some effect upon the malaria parasite But beyond the fact that arsenic had not only a tonic and blood restoring effect but also some slight specific action on the parasite, no practical result accrued in the treatment of malaria

In regard to treatment with 606 however there seems reason to believe that it will take its place as one of the recognised effective means of controlling malaria when for some reason or another the usual methods of treatment with quinine are not applicable

The early trials of 606 by Nocht and Werner gave considerable promise, and the later more detailed observations of Nicolle and Conseil and of Werner have given us a very considerable knowledge of the action of this drug in malaria

Werner's first cases were treated with intramuscular injection of the drug in alkaline olution (method of Alt and Iversen), later intravenous injection and the combined method were used He was able to say, as a result of these experiments that 606 acted much more effectively upon simple tertian than it did upon the tropical parasite A single dose administered by intramuscular or subcutaneous injection or the use of the combined method caused the schizonts and gametes of simple tertian malaria to disappear from the peripheral blood within from 12 to 48 hours In infections with the tropical parasite however 606 was effective only in half the cases

Nicolle and Conseil examined only six cases, but these were observed very closely and kept under observation for

considerable periods They used small doses 3 to 4 gramme and had no accidents They came to the conclusion that the effect of 606 was very *manifest and that its action was very rapid*, producing immediate amelioration of symptoms, a fall in the temperature, and a rapid reduction of the number of parasites in the peripheral blood But the action was in their experience neither durable nor complete, for though the parasites were *greatly reduced in number, it was always possible to* demonstrate, their presence if the examination was sufficiently searching, and whilst the temperature remained low for some days after the injection there was eventually in every case a relapse Nicolle and Conseil also noted that whilst the simple *tertian large forms were very susceptible to the action of 606* the small rings were less so and crescents not at all

A still further contribution to the subject was made by Werner, who carefully studied the effect of 606 on the parasite in 27 cases His results with simple tertian were very satisfactory, the temperature falling and the parasites disappearing usually within 24 hours and often within 12 hours Nor in these cases was there any return of infection whilst they were under observation Werner's results with malignant tertian show however very clearly that in regard to this form of parasite there is not much to be expected from treatment with 606 In most cases there was a reduction in the number of parasites, but these did not entirely disappear In others no effect at all was produced Crescents were unaffected, and in two cases the use of 606 did not prevent *the appearance in* due course of *crescents* following upon an infection of tropical rings

The use of 606 in malaria would seem to be reserved for cases which are very resistant to quinine or *require an urgent* amelioration of symptoms

Nicolle and Conor *Application du 606 au traitment du Kala Azar*

Bull de la Soc Trop Exot T III, No 10, December 1910, page 717

Nicolle and Conor inoculated a dog by intraperitoneal injection with a strain of *Leishmania* which had for a number of generations caused fatal results in dogs Nineteen days after inoculation the spleen was punctured and the presence of *Leishmania* ascertained; and 57 days after the injection the spleen was again punctured and numerous parasites found Three days later the animal received intramuscularly 2 gramme of 606 Four days after the injection three effective punctures showed no parasites the same result was obtained on the 7th, 10th, and 14th day Post mortem the spleen was enlarged, but no parasites were to be found

Skrodzki —*Arsenophenylglyzine bei Hamoglobinurie* Arch f Schiffs u Trop Hyg t XIV f 22 1910, page 707

Treated a case of Blackwater with arsenophenylglyzine The day after the administration there was no haemoglobin in the urine and the temperature fell

Cazeneuve —*L'hivernation des moustiques dans la Chine du Nord*

Bull de la Soc Path Exot, Table III, No 3 March 1910 page 155

Annett and Dutton have described the hibernation of adult anopheles, Galli Valerio and Narbel also James and Wright have described the hibernation of larvæ Cazeneuve brings forward facts to show that in very extreme climates the preservation of the species may depend upon the eggs In May and October the climate of North China is hot and moist (27° to 28° C) and mosquitoes breed freely In December and January it may descend to a minimum of 32° C After the first of November C failed to find either adults or living larvæ To ascertain whether living eggs were

present, the author removed blocks of ice from the frozen marsh water and kept these in flasks at a temperature of 6° C Six weeks later various forms of life were seen, amongst which were 8 anopheles larvæ, six of which died and two of which eventually reached the adult stage The thaw appeared from the 15th March to 1st April On the 19th of April numerous anopheles larvæ, many of which hatched out were captured

Legendre —*Sur la destruction des moustiques adultes a l'aide du filet a pap llons* Bell de la Soc Path Exot T III, July 1910, page 457

Legendre —*Sur la destruction des cuicines a l'aide du gite piege Ibid*, page 455

The author uses a net for capturing adults and employs artificial breeding places as traps for the destruction of mosquitoes in his hospital

Malcolm Watson —*A ne v anophelme from the Federated Malay States* Annals of Trop Med and Parasit, Vol IV, No 2, page 251

Watson records a new anopheline, *M aurirostris*, from the Malay States It is a small brown species with unbanded legs differing from previously described unbanded legged myzomyias in having four white bands on the palps and the apical half of the proboscis golden scaled

Gough —*On a collection of Anopheles made at Onderstepoort in the autumn of 1909* Report of the Govern Vetern Bacter for 1908 1909, Transvaal

The species previously known in the Transvaal were *P costalis*, *M funesta*, both common forms in Tropical Africa, *P cinereus P marshalli P aureosquammiger, My mauritianus* (near *My paludis* a common Tropical African form), *N pretoriensis N maculipalpis* (this is Theobald's *maculipalpis* differing slightly from James and Liston's *maculipalpis* which Theobald calls *N indiensis*) and *C squamosa* The

author also records *Nm rossi* the geographical distribution of which is usually considered as not extending so far west To this list Gough adds *M rhodesiensis N natalensis*, a variety of *M pretori nsis M rufipes* and two new species, *C argenteolobata* and *C pretoriensis*

Isthmian Canal Commission —*Report of the Department of Sanitation for September 1910* Ref Jour R A M C, December 1910

Some remarks on habits of anopheles in connection with screened buildings Anopheles which have been hiding during the day in the protected rooms make numerous attempts to leave about 6 P M

Mathis and Leger Bull de la Soc Path Exot, 1909, page 577

Mathis and Leger —*Le paludisme au Tonkin Index endemique pendant la saison fraiche Ibid* T III, No 7, 13th July 1910, page 465

In the months of October 1909 (cold season) to March 1910 (hot season) inclusive, the authors have examined the blood of 2,133 children of ages from one month to 15 years, 1 697 being under 5 years of age Great differences were found in the endemic indices of different areas On the coast land and Delta the index was very low, being practically o per cent In the valley of the *Riviere Rouge* the rate was higher, 12 per cent, whilst in the valley of the *Riviere Claire* and *Riviere Noire* it was very high, being 22 per cent and 29 per cent respectively In the North West Frontier district the rate was low—4 per cent

Between the rate in the cold season and that in the hot season there was not much difference Taken collectively, the rate was 7 33 per cent in the hot weather and 5 83 per cent in the cold

The spleen rates are not given, but it is possible that the coast area would come under the definition of a healthy area (spleen rate under 5 per cent), whilst it is pretty certain that the valleys of the *Riviere Claire* and *Riviere Noire* would be included as hyper endemic (over 50 per cent) *Vide* note on page 25)

Analysing the results with reference to age, Mathis and Leger found that among children of 1 month to 5 years 58 3 were infected and among *children 5—15 years 66 5 per cent* There is thus no distinct difference in the parasite rate at different ages The matter is an important one as, if this were *not the case, grave difficulties would be introduced in obtaining* an index, it being obvious that if infection varied greatly with age, one's result in any given case would be dependent very *largely on the proportion of children of different ages in the* sample

In regard to the type of parasite present at different ages, *the authors found that in infants under 1 year the percen* tage proportion of the different parasites was simple tertian 50 per cent, malignant tertian 33 3 per cent and quartan 16 6 per cent Taking *children in two groups, namely, those* of from 1 month to 5 years of age and those of from 5—15 years, the percentage of simple tertian was seen to diminish with age from 52 4 per cent in the first group to 13 *per cent in the* second Quartan was about the same in the cold weather in the two groups, but malignant tertian was twice as frequent in the second group, 77 6 per cent *as it was among the younger* children, 30 3 During the hot weather both groups had an equal proportion of malignant tertian (30 per cent), but the proportion of quartan was *doubled for children under 5*

Among indigenous adults admitted *to hospital on* account of fever Mathis and Leger found the proportions for simple tertian, quartan, and malignant tertian to be in the cold weather 8 per cent, 11 *per cent and* 79 per cent respectively, and in the hot weather 15 per cent, 25 per cent and 58 per

cent respectively Thus there is always a great preponder of malignant tertian among indigenous adults suffering f fever

Calvocoressi —*Die malaria unter den Mekka pilg* Zeit fur Hyg f I, 28th October 1910

The author has examined Mekka pilgrims as they pass station at Tor in the Red Sea He has met with many ca of malaria, mostly relapses The proportion of the differ parasites has been malignant tertian 71 9 per cent, simple tian 24 per cent, quartan 3 5 per cent, and mixed malign tertian 3 per cent

Janni Policlinico Rome December 1910, Ref J Amer Med Assoc, 21st January 1911, page 231

Janni has examined over 2,000 temporary or perman inhabitants of endimic foci of malaria He found parasite 53 of 146 persons free from the slightest indication of mala disease (*vide* PALUDISM, No 2, page 111) When no paras were found at a first examination Janni administered a th peutic dose of strichnine In many cases within 30 to minutes parasites appeared in the peripheral blood

Sorel —*Le paludisme a la cote d'Ivoire* Bull de la S Path Exot IV, No 2, page 108

Sorel has investigated the endemic index on the Iv coast The total number of children examined wa 988 the percentage infected 45

In children from 1—5 years of age the parasites were fo in 56 per cent, in children 5—15 years of age in 38 per ce and in children over 15 years in 43 per cent The most quent parasites found were quartan and malignant terti simple tertian was rather rare In one locality conditions w unfavourable to the breeding of anopheles and the aut believes that such as were present were largely imported

Trincas —*Il valore del l'indice splenomegalico nel l'epidemiologia della malaria* Policlinico Sezione pratica Fasc 27 I Ref in Arch f Schiff u Trop Hyg XV 9

Trincas has studied the splenic index in 309 children in its relation to age, sex, economic condition of the parents, dietary and type of fever present He concludes that splenic enlargement is most frequent and greatest at the age of 2—5 years, in the female, in the poor, and in the badly nourished The type of fever most concerned is given as quotidian, possibly a clinical definition He believes that the significance of splenic enlargement is chronicity of infection, and thinks that the intensity of epidemic conditions has nothing to do with the amount of splenic enlargement

Muhlens —*Uber einheimische Malaria quartana* Deut Med Woch 42, 1910, page 1948

States that quartan is very rare in N W Germany, but records two cases the origin of which was obscure

W M James —*Quartan malaria and its parasite* —Proceedings of the Canal Zone Med Soc, Vol III, April—September 1910

A record and description of the quartan parasite —James states that quartan parasites are not commonly encountered in the Canal Zone Typical quartan paroxysms of fever even *in cases showing the parasite are scarcely ever seen* In addition to a minute description of the schizonts, the author gives some valuable information regarding quartan gametes As quartan is a form of malaria very liable to relapses, the author has studied the question of parthenogenesis In both tertian and quartan all the forms described by Schaudinn were seen, but only when asexual forms were also present All degrees of atypical sporulation between a normal segmenting form and the so called segmenting macrogamete were also

seen, but the author found it impossible to say whether 'parthenogenetic" forms were atypical schizonts or sporulating macrogametes James describes a peculiar form of the parasite which is distinct from either the schizont or the gamete

Brem —*Clinical studies of malaria in the White Race* — Archives of Internal Medicine Chicago Ref Jour Amer Med Assoc

In the White Fever Wards of Ancon Hospital during 1905 and 1906 out of a total of 1,300 patients 1,107 were admitted for malaria In 705 or 63 7 per cent of these parasites were found, the proportion of the different species being aestivo autumnal 63 4 per cent, tertain 32 9 per cent No quartan parasites were encountered Mixed infections were found in 3 7 per cent of cases showing parasites Three systems of quinine administration (curative) were tested *viz*, (1) 30 grains daily in three doses of 10 grs at 6 8, and 10 A M, (2) from 30 to 40 grains given in 5 grain doses every four hours, (3) 20 grains daily in two doses of 10 grains The febrile period was approximately equal under systems (1) and (2), it was much longer under system (3) Of the three methods the first was on the whole preferred

Low —*The duration of infection of malaria* —Jour of Trop Med, 15th November 1910, page 342

The author records the history of W, the second volunteer, bitten by infected anopheles brought from Italy by Low and Sambon The initial attack was in September 1900 There were several relapses in the course of the next two years and parasites (benign tertian) were found at the time of a relapse in 1903 Low refers also to the case of P M, the other volunteer, who had an attack nine months after the initial attack, though this was followed by three months' quinine treatment and calls attention to tne difficulty of determining the recovery rate in untreated cases

Urriola.—Ref. Lancet, 28th January 1911, page 252

Urriola states that malarial infection can be ascertained even when parasites are not found in the blood by the detection of malarial pigment in the urine. A sample of urine carefully collected is centrifugalised and the sediment examined. The pigment may occur in clusters or in hyaline casts, etc. Prolonged search is sometimes required. The possibility of the detection of malarial pigment under the circumstances seems rather doubtful, but the correctness of the contention might easily be put to the test in severe cases of undoubted malaria.

Deaderick.—*Recurrences in malaria.* Bull. de la Soc. Path. Exot. T. III, No. 8, October 1910, page 498

Sums up briefly different views as to the causes of long relapses. The theories to explain the phenomenon of long relapses are given as three—(1) feeble schizogonic reproduction in the spleen and elsewhere; (2) intracorpuscular conjugation with the formation of a zygote stage or resting body; (3) parthenogenesis. The author inclines to the last theory. We may draw attention in this connection to the work of James at Panama (*vide* reference in present number of this journal), in which he refers to the impossibility of deciding with certainty between ordinary or atypical sporulation and sporulating "gametes." It should not be forgotten that ordinary sporulating benign tertian parasites often show some delay in the splitting up of the chromatin, and experience teaches one to be rather careful in making a confident diagnosis of such forms. The impression gathered from a number of references to gametes is that more experience would have caused the writer to define his diagnostic signs more carefully. If one takes as a definition of a macrogamete, merely what one considers to be a full grown form in which the chromatin does not show signs of division, one will have ample opportunity of seeing such associated with sporulation

Donzello —*Campaign against Malaria in Sicily* Policlinic Rome, February 1911 Reference Jour Amer Med Assoc, April 1911, page 1013

As people in the selected area were debilitated from repeated infections, the campaign was kept up throughout the winter in the hope of effecting a permanent cure In spite of this, malaria recurred in 5 7 per cent The general condition of the people was, however, much better than it had been and the spleens were materially reduced in size Preventive treat ment in the preceding summer was given to 33,387 people, six grains being given every second day No cases of pernicious malaria occurred whilst only 2 6 per cent among the agricul turists and 1 3 per cent among miners had attacks There was no mortality The results were thrown into bright relief by contrast with the prevalence of fever among the people outside the treated area

Ross, Thomson and Simpson —*A case of Blackwater fever followed by a peculiar relapse without haemoglobinuria or detectable plasmodia* Ann of Trop Med and Paras itology, Vol IV, No 3, page 307

The authors record a case of blackwater fever in which the attack supervened whilst a daily count of parasites was in progress No parasites were seen during the blackwater or during a second attack of fever following this, but unasso ciated with haemaglobinuria, nor were any other forms of parasite seen As previously noted by Christophers and Bentley, the amount of haemoglobin passed calculated in terms of actual blood represented is very small But the authors' conclusion that haemoglobinuria is a small overflow of the freed haemoglobin which the liver has not been able to deal with is rather misleading and scarcely does justice to recent researches on this disease Both Christophers and Bentley and Barrett and York show distinctly that haemoglobinuria occurs as a consequence of the existence of even a trace of

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free haemoglobin in the blood It is not, as was formerly supposed (and as the wording of the authors' conclusion would seem to indicate), only when a great excess of haemoglobin is present that haemoglobinuria occurs, (*vide* the next article)

Simpson —*On Haemoglobin metabolism in Malarial Fever* Ann of Trop Med and Parasitology, Vol IV, No 3, page 313

The author draws attention to the importance of estimating the faecal urobilin as well as that present in the urine if one wishes to arrive at the total output of this derivative of haemoglobin The method employed to estimate the urinary urobilin was to determine the dilution at which the spectrum of urobilin just became invisible when the solution was examined in a layer 15 mm thick This was then compared with standardised solutions of pure urobilin In the case of faeces the urobilin was extracted by shaking with large amounts of water acidulated with sulphuric acid After exposure to day light for some time the amount of urobilin was then estimated by the same method as that employed for urine In cases of simple tertian malaria the author finds no increase of urobilin excretion beyond that to be expected from the amount of febrile disturbance present In malignant tertian the urobilin excreted is much in excess of this In Blackwater fever the amount, considering both urine and faeces, is enormous and equal in the particular case examined to the equivalent of the total blood haemoglobin In stating that the normal channels are capable of dealing with free haemoglobin, the author says that a severe strain, equal to 25 per cent of the total circulating haemoglobin, can be sustained without causing haemoglobinuria This must surely be an error, for Barrett and York give up to only 25 per cent of the red cells or a mere trace of haemoglobinaemia This latter determination is in fact tantamount to saying that a very slight degree of solution of the red cells in the peripheral blood leads to haemoglobin

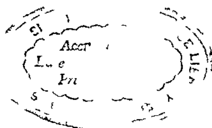
aemia—a conclusion in accord with actual observations on Blackwater fever cases in which haemoglobinaemia however slight, is associated with haemoglobinuria

Manceaux *Sur la technique de culture des Leishmania* Bull Soc Path Exot Vol IV, p 286

The following medium for the cultivation of Leishmania is recommended —

Distilled water	900 grammes
Agar agar	14
Sodium chloride	6
Rabbit s blood	1 part to 3 parts of agar agar

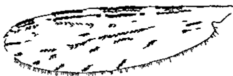
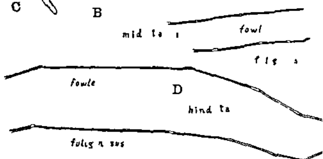
The following is the method of preparing the medium Macerate the agar agar in a cristalliser containing distilled water After five or six hours change the water and after 24 hours drain it off Then to the melted agar agar add sufficient distilled water to make the weight 914 grammes Then add 6 grammes of sodium chloride Dissolve, filter and pour from 3 to 5 c c into each test tube Sterilise Remelt the medium and after allowing it to cool to 53°C to 55°C add the required quantity of rabbit's blood obtained aseptically from the heart Incline the tubes and the next day test their sterility by incubation The parasites develop best at a temperature of 20 to 22°C



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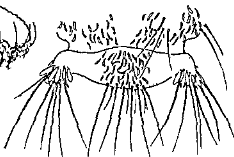




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Leslieomyia tæniorhynchoides nov sp